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THE PROCEEDINGS

OF THE

THIRD
ALL-INDIA
SANITARY CONFERENCE

HELD AT

LUCKNOW

January 19th to 27th, 1914

VOLUME IV

PAPERS

CALCUTTA
THACKER, SPINK & CO

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CONTRIBUTION TO THE STUDY OF MALARIA IN GOA.

BY

DR. FROILANO DE MELLO,

Delegate of the Government of Portuguese India.

MALARIA occurs endemically in Gôa: this statement practically includes all previous assertions on the subject. Indeed, almost nothing has been done, either towards the study of the anophelines of our country, or the determination of regional splenic indices. Entomological work requires a sanitary staff accustomed to this kind of research and the collection of mosquitoes also demands special brigades. Unfortunately doctors trained in the Lisbon School of Tropical Medicine who began to come to India some six or seven years ago, have had their time completely occupied with other numerous duties connected with the sanitary service. The attempts that I have made to avail myself of the help of sanitary officers in the collection of mosquitoes have completely failed. It is sufficient to say that, up to the present I have not seen a single specimen of *Anopheles atkeini* which English authors state to be common on the Gôa frontier. At Nova-Gôa the mosquitoes that have been caught belong for the most part to the species *Nyssomyzomyia rossi: A stephensi* apparently occurs (J. Barreto) but it is rare. There are large numbers of *stegomyia, culex fastigans, impellens* and *cynereus* (J. Barreto).

My object in referring to these attempts in this memoir is simply to show the Conference that our work on malaria has made small progress chiefly because of the multiplicity of duties that fall to the lot of such a small number of doctors, and of a lack of inclination and personal enterprise.

Likewise as regards prophylaxis very little has been accomplished, and with the exception of earthworks at Nova-Gôa, undertaken more for the sake of beautifying the town than with any sanitary aim in view, we have only a wise decree of the Republican Government, adopted to meet local requirements by the Board of Health, a decree, the carrying out of which will be very slow, but tenacious and persistent, and courses of Hygiene at the Normal College (in addition to Hygiene and Tropical Pathology at the school of medicine), where are trained the future primary teachers, who have been up to the present among the first to succumb to attacks of malaria, showing that they have not followed anti-malaria rules themselves: in short, we have no definite settled policy. I am, however, glad to be able to tell the Conference that some useful measures will be carried out in the course of the coming year. Problems of public administration attracted very little notice from public authorities before the inauguration of the new form of Government that now rules us: and in spite of all the disturbances which revolutions in general inflict on Society during their early years, the Portuguese Republic has given high place to sanitary matters, and I am authorised by His Excellency Dr. Couceiro da Costa, Governor-General of Portuguese India, to say that a special Bureau of Malaria will be established to study as thoroughly as possible the various problems connected with the question of malaria in our province.

Quite otherwise is the rôle played by the doctors trained in our College; in stating this I do not wish to give you the idea that they have extolled the use of mosquito-nets or drainage or carried out other anti-malaria propagandism, inasmuch as I rarely see these measures in use even in the most distinguished families, but I allude to the collective prophylaxis which has naturally resulted from the efficient treatment of patients suffering from malaria. One fact is most remarkable; certain localities which a few years ago were considered to be eminently malarious, notably Nova-Gôa, the capital, are at the present time very healthy. May it be that the species of anophelines have changed? It cannot be said that the earthworks at Nova-Goa have brought about extinction of mosquitoes which exist in great abundance, notably *Stegomyia*, and *Nyssomyzomyia rossi*, and there are no reasons, I believe, to think that other dangerous species of anophelines could have disappeared whilst *M. rossi* flourishes so well. It is then to medical treatment, to therapeutic quininisation, that I attribute the comparative healthiness of *Velhas Conquisitas* which is well supplied with doctors, and more particularly of certain localities which

TABLE I.

Year.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.		TOTAL	
	General diseases.	Malaria.	General diseases.	Malaria.	General diseases.	Malaria.	General diseases.	Malaria.	General diseases.	Malaria.	General diseases.	Malaria.	General diseases.	Malaria.	General diseases.	Malaria.	General diseases.	Malaria.	General diseases.	Malaria.	General diseases.	Malaria.	General diseases.	Malaria.	General diseases.	Malaria.
1903 ..	108	39	89	20	84	21	76	17	83	29	89	35	94	21	104	27	123	48	117	34	123	40	92	25	1,182	356
1904 ..	94	18	112	25	110	20	123	23	114	34	120	41	124	50	127	31	105	23	128	36	223	27	112	30	1,492	360
1905 ..	99	13	112	16	81	8	77	14	81	16	102	19	82	28	142	25	118	37	131	54	126	33	126	42	1,277	305
1906 ..	109	41	100	35	108	28	112	47	113	36	115	32	122	48	111	44	148	59	118	49	112	29	98	35	1,366	438
1907 ..	100	13	85	16	89	21	132	39	119	46	104	39	121	53	115	57	104	29	117	35	126	34	81	20	1,293	402
1908 ..	114	17	94	12	78	15	68	14	95	22	117	25	71	19	107	31	141	54	104	47	101	23	106	19	1,196	298
1909 ..	86	17	72	10	65	10	53	9	78	15	88	25	144	45	81	21	95	28	88	14	87	24	98	19	1,033	237
1910 ..	106	17	78	20	66	16	85	30	90	23	72	18	93	29	94	15	96	18	140	27	133	23	142	34	1,195	270
1911 ..	145	34	74	11	83	17	77	22	98	26	124	26	91	20	92	18	88	16	94	21	89	9	86	20	1,141	240
1912 ..	72	15	85	19	18	18	59	7	144	39	96	10	107	16	162	19	155	27	167	27	86	16	166	37	1,382	250

were formerly eminently malarious. It is even possible that this quininisation may have in some way attenuated the virulence of the malaria parasite.

Several problems come to mind in connection with the question of the malaria parasite. In the first place, the three varieties admitted by the majority of authors do not explain certain quotidian fevers in which the most careful examination of the blood does not reveal a single generation of parasite in a phase of schyzogenic development which would explain an attack if it were due to one of these three parasites, malaria, vivax, and præcox. Secondly, out of a total of 1,147 cases of malarial fever and malarial anæmia, I have only met with one solitary case of pernicious fever.

In another series of 200 cases I came across another case of pernicious fever and a case shewing choreiform movements, due to malaria, which yielded to quinine injections, and which was probably consequent on a pernicious attack, for the patient treated outside hospital was said to have had high fever with delirium for three days. The doctors of *Velhas Conquisitas* who have been consulted also state that pernicious attacks are rarely met with, bilious malarial fever still more rarely, but what is curious, numerous emigrants who return from Africa frequently suffer from pernicious attacks and bilious fevers. This cannot be explained solely by a differing anopheline fauna but more likely by a larger number of species of malaria parasites.

The individual factor should be almost negligible in these various forms of malaria, that is to say, the factor of individual immunity reaction. Malaria has been present for a long time in Gôa, and in Novas Conquisitas it continues to be as virulent and as prevalent as formerly, largely attributable to more dangerous varieties of anophelines (*A. atkeini*), to insufficient medical aid and treatment with quinine, and perhaps to different forms of parasite to those which are met with in Velhas Conquisitas.

The above shows how much there is to investigate and this I hope to do with the help of Government during my stay in Portuguese India.

Gôa is eminently malarious. An examination of the Military Hospital registers since 1903 has given me the figures set forth in Table I which show well the degree of malarial infection of our country.

To give an idea of the severity of malaria, I will quote some figures borrowed from the inaugural thesis of one of our distinguished pupils, Mr. J. Barreto, taken from the mortality tables published by the Sanitary Office of Portuguese India.

TABLE II.

Diseases.	Number of deaths.	Total deaths.
Malarial fevers	1,014	11,037
Remittent fevers	1,317	
Pernicious fevers	58	
Bilious fever	1	
Malarial Cachexia	201	
Small-pox	377	
Cholera	71	
Dysentery	138	
Typhoid fever	164	
Pulmonary tuberculosis	471	

These last figures struck me as strange: they are however taken from official documents, the mortality statistics of the sanitary office. It often happens, however, that patients die without medical assistance and these deaths are apt to weigh heavily on the malaria column. This table is therefore very far from being an expression of fact.

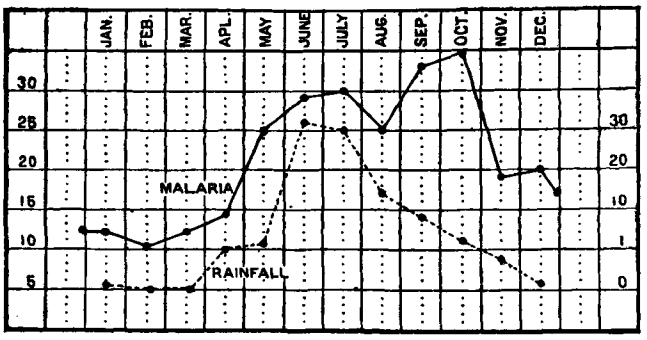
By studying 183 cases of malaria admitted to hospital between November 1912 and September 1913 suffering from acute attacks of fever I have been able to establish the comparative frequency of the various kinds of malaria parasites prevalent in Gôa. I say in Gôa because our patients come to us from all parts of Gôa from *Novas* and *Velhas Conquisitas* alike.

22 cases—parasite not classified.
17 cases—no parasites found (the patients had taken quinine).
15 cases—Plasmodium malariæ.
73 cases—Pl. vivax.
46 cases—Pl. præcox.
10 cases—mixed infection (vivax and præcox).

When we come to study the seasonal prevalence of malaria we see that malaria usually increases in the rainy months and that there is a close correlation between

the two curves (*see* chart No. 3). The number of cases increases with th increase in rainfall. I show in the chart figures representing the rainfall from 1903-1912 which, when compared with the number of patients admitted to hospital, gives an approximate idea of the relationship between the degree of malarial infection and the rainfall.

CHART No. 3.



Outside the *Novas Conquistas*, more especially the departments of Quepém, Sanguém, Satary, Canácona, there are in the *Velhas Conquistas* certain places which are considered eminently malarious, notably Rachol, Velha Gôa, Choráo, etc. No actual study has been made on this subject, we only know that topographical conditions of these places lend themselves admirably to the development of malaria (marshy regions, rice cultivation, etc.), whilst other villages are according to the doctors absolutely free from malaria.

Clinical description of malarial fevers founded on cases observed in the Military Hospital of Nova-Gôa.

Shivering occurs in nearly all cases: it is most marked amongst European soldiers who are attacked for the first time. In a minority of cases shivering is not marked and is replaced by headache, pains in the joints or a feeling of fatigue and backache.

However, when the patient is anæmic and has already had numerous attacks of malaria, shivering does not occur and fever comes on without the least premonitory symptom.

Headaches are especially marked in first attacks. In anæmic patients whose blood occasionally shews no parasites but a well marked mononuclear increase, and whose condition pre-supposes a former heavy malaria infection, frontal neuralgias are also seen as well as sciaticas which exhibit periodicity, and which treatment with quinine or arsenic succeeds in checking. The periodicity is one of the best arguments in favour of the malarial nature of these symptoms.

In the cases I have seen I have observed no changes in the organs other than enlargement of the spleen in chronic cases. In acute malaria the spleen is not enlarged.

The duration of fever before admission to hospital cannot be accurately ascertained; it was usually some days, but I believe not more than eight.

The duration of fever in hospital is set forth in the following table, which has been constructed from an analysis of cases of malaria admitted to hospital from 1902 to 1912:—

Amongst 708 cases of fever—

271	had	fever	for	1	day.
123	„	„	„	2	days.
64	„	„	„	3	„
18	„	„	„	4	„
10	„	„	„	7	„
7	„	„	„	5	„
5	„	„	„	6	„
5	„	„	„	8	„
3	„	„	„	10	„
1	„	„	„	9	„
1	„	„	„	12	„
1	„	„	„	15	„
1	„	„	„	20	„
198	admitted to hospital without fever.				
708					

According to the regularity of the temperature chart.

Duration in days.	Regular curve.	Continued fever.	Delayed attack.
1	254	17	0
2	89	Continued for one day 18	16

Irregular fevers that do not lend themselves to any classification 36
Regular tertian fevers 32
Double quartan fever 2

The length of stay in hospital for these patients has been :—

3	remained	in	hospital	3	days.
49	,,	,,	,,	4	,,
47	,,	,,	,,	5	,,
42	,,	,,	,,	6	,,
37	,,	,,	,,	7	,,
32	,,	,,	,,	8	,,
7	,,	,,	,,	9	,,
30	,,	,,	,,	10	,,
15	,,	,,	,,	12	,,
6	,,	,,	,,	13	,,
2	,,	,,	,,	14	,,
6	,,	,,	,,	15	,,
3	,,	,,	,,	16	,,
2	,,	,,	,,	18	,,
4	,,	,,	,,	29	,,
1	,,	,,	,,	22	,,
9	,,	,,	between	22 & 33	days.

Studying the length of individual attacks of fever, I have obtained the following figures :—

Attacks of fever.	Length of attack of fever without intermissions in hours.
1	2
149	3
1	4
1	5
78	6
34	9
1	10
20	12
6	15
1	18
1	21
1	30
1	33
2	36
1	48
1	59

With regard to the hour of the day in which the attack of fever commenced, I find in .. 39 cases fever began between 6 A.M. and midday.
249 ,, ,, ,, ,, midday and 6 P.M.
34 ,, ,, ,, ,, 6 P.M. and midnight.
10 ,, ,, ,, ,, midnight and 6 A.M.

Finally studying the temperature charts with respect to the time of onset of the attack and the periodicity and duration of fever, I obtained the following figures :—

	Between midday and 6 P.M.	Between 6 P.M. and midnight.	Between midnight and 6 A.M.	Between 6 A.M. and midday.
Fevers of one day's duration	82	8	3	3
Fevers of two days' duration with two regular periodic attacks	25	3	..	..

Fevers of two days' duration irregular as far as their periodicity is concerned .. 21
Fevers of 3 or more days' duration { Regular 10 / Irregular 19

Malaria in Gôa is usually benign. Pernicious attacks are very rarely met with, bilious remittent fever practically never.

The time has come to say that practitioners too often abuse the clinical term malarial remittent fever. Malaria fever is essentially cyclic, intermittent, its cycle

depending on the variety of parasite, but when different generations of the parasite invade the organism at very short intervals, the curves are superimposed and the normal chart is not obtained. The name remittent fever readily lends itself to confusion especially in the tropics where the remittent type of fever is so common in numerous other diseases. To demonstrate this abuse I reproduce here some temperature charts of these so-called malarial remittent fevers. In analysing these more closely it is seen that this remission is a masked intermission.

Case No. 1.

Diagnosis :—Remittent malarial fever.
Duration of disease before admission to hospital—some days.
(*Archives de l'Hopital Militaire, 30th December,* 1910).
This fever is purely intermittent: and lasted for 45 hours.

Case No. 2.

Diagnosis :—Malarial remittent fever.
Duration of disease before admission to hospital—not known.
This is also clearly a case of intermittent fever.

Case No. 3.

Diagnosis :—Malarial remittent fever.
Duration of disease before admission to hospital—15 days.
The case is one of intermittent fever in which different generations of parasites gave for several days a continuous character to the temperature chart. The fall to 37·5 on the 5th day followed by an immediate rise is rather a masked intermission like that of the following days and signifies the death of some of the generation of parasites.

Case No. 4.

Diagnosis :—Malarial remittent fever.

Duration of fever before admission to hospital—39 days (?). This fever is very far from being remittent. It is intermittent with attacks of fever continued over several days and finally ends by being frankly intermittent, but the intermission only lasts a very short time (due almost certainly to the large number of generations of parasites).

Case No. 5.

Diagnosis :—Malarial intermittent fever.
Duration of disease before admission to hospital—some days.
In this case, classed as an intermittent fever, the tendency of the fever to become continuous for 36 hours and the fall by lysis is clearly seen ; treatment with quinine having killed some of the generations of parasites, the fever becomes intermittent and the attacks of fever become of shorter and shorter duration. This is a very common type of malarial fever in Gôa.

Case No. 6.

Diagnosis :—Malarial remittent fever.
Duration of the disease before admission to hospital—several days.
In this case one sees that the fever was continuous for the first three days and then rapidly fell to sub-normal.

Case No. 7.

Diagnosis :—Malarial remittent fever.
Duration of the disease before admission to hospital—" a long time".
In this case the continuous nature of the fever with a progressive tendency for the falls to become lower each time until the sixth fall, when the temperature reaches sub-normal, is well shown. The relapse on the following day combined with the first part of the chart shows us that there was more than one generation of parasites.

As for treatment I have never used other than the hydrochloride and the bi-sulphate of quinine in acute attacks. My dose for an adult is one gramme in two cachets taken six hours after the attack with hydrochloric lemonade. I frequently use injections of 0·50 of hydrochloride of quinine. Occasionally I have used more than two injections and following treatment by mouth, I only continue it for three or four days. Adrenalin, compound quinine wine, are valuable adjuvants during convalescence, and injections of cacodilate of soda are of real value in the irregular attacks of the malarial cachectic. Many of my colleagues quininise their patients

by means of fractional dosages throughout the whole day, whilst others never give larger doses than 8 decigrammes. Cinchona febrifuge introduced into Gôa by Surgeon-General Costa Olvares is very efficient in tertian fever, and often acts better and more quickly than quinine even if the latter be injected (Prof. V. de Faria).

The only complication that I have seen supervene during treatment, excepting quinine intoxication, was one case of hæmoglobinuria due without doubt to a hæmolytic jaundice. The hæmolytic agent seems to have been quinine, although no definite assertion can be made on the subject.

Prophylaxis.

Prophylaxis of malaria in Gôa is about to be regulated and carried out in accordance with the decree of which I give a translation, issued by M. the Governor Coucerio da Costa, at the suggestion of the Board of Health, who were desirous of adopting the anti-malarial decree of the Colonial Department to the requirements of Portuguese India.

Decree No. 133 *of the* 14*th March*, 1913.

Whereas the decree of the 14th October, 1911, cannot perhaps be carried out in its entirety in this province, not only because certain measures therein extolled such as levelling, drainage, and the reclamation of alluvial soil are more costly than the resources of the treasury allow, but also because agriculture has need of all collections of water, and orologic and climatic conditions appear in a form peculiar to this part of the tropical zone.

Whereas malaria does not appear here in so grave a form as it does in Africa, and only occasionally appears as pernicious fever, a noteworthy fact; whereas patients in malaria hospitals are frequently seen suffering from gastro-intestinal infections.

Whereas it is most expedient for the public health that sanitary measures founded upon the decree already referred to should be put in force as soon as possible, but the selection of such measures must be subordinated to the questions of expense and feasibility in the principal centres of population.

The Governor-General of Portuguese India, agrees with the Board of Health, and after having submitted the subject to the Council of Government who have considered it in to-day's sitting, accords his approval to the standing orders for sanitary measures established by the decree of the 14th October, 1911, which will be published in the official Bulletin signed by the General Secretary, and will form an integral part of that decree.

Regulations.

Article 1.—At Pangim, Vasco de Gama, Marmugáo, Mapuçá, Margáo, in the chief places of Pondá, Perném, Bicholim, Sanquilim, Sanguém, Quepém, Canacona as well as in those of Damáo, Diu, and Nagar-Avely, the following measures will be enforced in an area which includes, other than the places named above, a peripheral belt of 500 metres around them:—

(*a*) Filling in with earth or drainage will be employed in all depressions, marshes, swamps which allow rain water to stagnate or other collections of water not used for drinking, in such a way as to render these depressions, marshes, or swamps dry and incapable of allowing such stagnation.

(*b*) Water-courses, canals, lakes, and ponds which are not designed for drinking but which are absolutely necessary for agriculture or for water communications will be cleaned periodically with the object of trimming their edges and diminishing aquatic vegetation thus rendering them incapable of sheltering or propagating mosquitoes.

(*c*) In all lakes, cisterns, or permanent reservoirs larvicidal fish will be introduced with the object of destroying anopheline larvæ.

(*d*) In ponds in which water is kept for agricultural purposes and where the size and depth permit, herds of animals will be introduced periodically to stir up the water thus making it unsuitable for anopheline larvæ.

(*e*) Cisterns, tanks, and other receptacles which contain drinking water, if of no very great size, will be protected from mosquitoes by wire gauze; their owners will be responsible for the state of repair of this wire gauze and their cleanliness, and also for the closing of all holes which the public are forbidden by the sanitary authority to use.

(*f*) With the object of preventing the development of mosquito larvæ, it is forbidden to keep in yards, gardens, or other appendages of dwelling-houses any old pots or rubbish capable of holding water.

(*g*) All vessels intended to hold water for drinking or for other domestic purposes, will be closed and their contents changed at least every two days, thus preventing the development of larvæ.

(*h*) All useless vessels, their pieces, or any other object which from its shape might collect water (cocoanut shells, old basins, etc.) will be destroyed, buried or burnt according to their nature, thus preventing their forming small collections of water: it is necessary to recall that it is in these small collections of still water that mosquitoes find the best conditions for their development.

(*i*) Wells will be covered in such a manner as to prevent the entrance of mosquitoes and gradually, within one year from date of publication of these regulations, they will be provided with pumps so that the wells can be closed completely and water extracted therefrom by mechanical means.

Note.—The designation "puit" does not include temporary ditches dug in cultivated ground for the irrigation of vegetables or other crops as is the custom in this country: it is however obvious that these ditches should be kept clean and the water stirred up, or protected when the water is not in motion, from invasion by mosquitoes; this can be done in practice by covering them with palm leaves, planks, etc.

(*j*) Public wells used for drinking water will be immediately closed and provided with pumps: this hygienic measure is recommended also to avoid the possibility of transmission of gastro-intestinal disease due to contamination of drinking water by vessels dipped into it.

(*k*) Plots of ground, or uncultivated garden will be cleared at least twice a year of all grass and useless shrubs: all others will be kept as tidy as agricultural demands allow.

(*l*) All roofs must be cleaned before and after the rains, and drains must be dug around houses, alongside the roads, in all plots of land and yards so as to prevent accumulation of rain water.

(*m*) All kitchen and bath water must be got rid of in such a way as to insure its rapid drainage or absorption into the soil.

(*n*) In all places that possess a drainage system all communication of pipes with the exterior must be furnished with wire gauze; oil should be poured in these openings to prevent the water in the syphons, or pipes acting as breeding-places for anopheline larvæ.

Article 2.—In all other places, villages, etc., of Portuguese India, the measures which have just been prescribed in the preceding article should be put in force in accordance with instructions of the local sanitary and administrative authorities who will inform the Board of Health which of these measures should be enforced immediately in these localities, villages, etc.

The Board of Health will then be able to send a delegate to judge of the local conditions and the need of the sanitary measures detailed by the local sanitary and administrative authorities, and he will notify Government of those places in which all these measures should be enforced, and those in which they should be enforced in part only.

Note.—Government will notify in subsequent decrees, localities in which the prophylactic measures enumerated in Article 1, are to be adopted in their entirety.

Article 3.—Lakes, ponds, marshes, ditches, pits or depressions which can harbour stagnant rain or other water, which are situated outside the localities mentioned in Articles 1 and 2 in regions that are exclusively agricultural, and which are used for agricultural purposes should be periodically cleaned, the water stirred up by herds of animals from time to time, and be kept clear of aquatic vegetation, more especially the lotus, so dangerous because of the water which collects in the calices of their flowers; the water should be changed, this can be done with the help of springs in the neighbourhood, and their edges should be trimmed. In these localities and during the rainy season, drainage of all water not required for agricultural purposes should be effected.

Note.—Fresh collections of water shall not be made without the approval of the bodies referred to in Article 6 and without *competent official sanction.*

Article 4.—All marshes or other collections of water which are useless for agricultural purposes and which are not used for water communications or for any industrial purposes shall be destroyed as far as possible by drainage, planting trees, agricultural devices and all other measures of drying up such areas advocated by sanitary engineering, compatible with local economic conditions. These measures

will be carried out with the help of Government, municipalities, temples or other corporations having agricultural or commercial interests in the locality to be benefited.

Note 1.—Until such times as these sanitary measures can be fully carried out, measures prescribed in Article 3 shall be enforced, and fortnightly oiling shall be carried out using 15 c.c. of crude petroleum for every square metre of liquid surface.

Note 2.—Petroleum should be applied to the surface of the water by means of a cloth at different points or by tying cloths to the end of long bamboos and passing them slowly over the surface of the water. This last method is suitable for collections of water of limited extent.

Article 5.—In each district there will be a Sanitary Committee whose duty will be to carry out these regulations: it will be composed of the administrative official as president, president of the municipality, the health officer, and a member selected by Government, from amongst the agriculturists or landed proprietors of the district and will be empowered to pass orders under the Act, or send direct to the Board of Health, such observations on the decisions of the local Sanitary Board, as it considers necessary.

Note.—These local Committees are competent not only to give full operation to these regulations in compulsory areas but also to propose to the Board of Health prophylactic measures, to determine their extent and *modus fasciendi* and to deliberate on the spot on the practical difficulties that may arise in the execution of these measures. These deliberations will be of a provisional nature only and should be submitted to Government for approval with the least possible delay.

Article 6.—In the event of any objection being raised to the carrying out of that part of Article 4, that relates to the destruction of collections of water that are considered useless, Government will nominate a Committee of competent officials and agriculturists in order to go minutely into the subject, after inspection of the locality if such be necessary. This Committee will then report to Government, who will issue orders.

Article 7.—Administrative Authorities, after having had official sanction, will supply the necessary personnel for sanitary brigades in each district to carry out the measures ordered by the Sanitary Committees (Article 5) and will provide funds for the working of these regulations.

Note.—The necessary personnel for these brigades will be determined by the aforesaid Sanitary Committees according to local needs and financial means. These brigades will be in charge of the health officer (*delegado de saude*).

Article 8.—No building will be permitted, be it in the nature of a house or other dwelling for human habitation, even though it may be in any particular estate or an enclosure shut in by walls, without the sanction of the Municipality based on technical advice of the sanitary and sanitary engineering officials. This regulation is only applicable to the chief municipalities of Portuguese India.

Note 1.—Municipalities should submit to Government within two months of the date of publication of these regulations in the Official Bulletin, projects connected with the execution of the decree of the 20th June 1906 according to Note 1 of Article 14 of the decree of 14th October 1911.

Note 2.—Article 21 of the rules cited in Note 1 of this Article will be rigorously enforced in the Province.

Article 9.—Municipalities who have not yet bye-laws to compel citizens to carry out indispensable rules of urban sanitation, will frame such within a period of 90 days from the date of the publication of this decree, and submit them for approval of competent authority. These bye-laws will in the first place be submitted for the approval of the Board of Health who will make necessary alterations.

Note.—In the case of Municipalities who are not competent to draft these bye-laws they will be framed by the Board of Health and submitted for sanction just as if they had come from the Municipalities.

Article 10.—All civil and military doctors and administrative or police officials, are empowered to look to the efficient execution of measures laid down in this decree: penalties, however, will only be enforced by the Police or Administrative Authorities.

Article 11.—This power of the Police or Administrative Authorities relates to all measures of public hygiene and sanitary policy necessary to combat efficiently conditions favourable to the development of diseases referred to in Article 1 of the decree of the 14th November, 1911, for the purpose of improving urban sanitation.

Article 12.—Municipalities should—

(*a*) place at the disposal of the Sanitary Authorities, all that is asked of them within the limits of their financial means;

(*b*) make provision in their budget for necessary funds, to carry out sanitary measures;

(*c*) carry out, as completely as their financial circumstances allow, all sanitary measures detailed in this decree to the end, that all conditions favourable to the development of mosquitoes may be eradicated from rural and urban buildings, within their jurisdiction;

(*d*) carry out necessary works in gardens, pavements, gutters, and drains, so as to prevent the stagnation of rain water therein;

(*e*) carry out sanitary orders given to citizens in such cases, where the citizens cannot execute them themselves within a stated time.

Article 13.—Administrative or Sanitary Authorities have the right of entry into all houses, establishments and out-houses: these visits will be made to public

establishments whilst such are open, and in the case of all other buildings, between sunrise and sunset.

Article 14.—The owners or tenants of rural or urban buildings, the heads of business establishments or their proxy, managers or their representatives as well as the tenants in cases which concern them, will be held responsible for the carrying out of these measures.

Note.—This responsibility falls upon owners, their proxy, or managers in such cases where the property is used by natives whose social condition is such as to relieve them of all responsibility.

Article 15.—Infringement of orders contained in these regulations will be punishable by a fine not exceeding two hundred rupees.

Note.—If the individual on whom such fine is inflicted does not pay the same voluntarily he will be proceeded against on an order of the *Ministère Public.*

Article 16.—Instructions shall be given either verbally or in writing by the Sanitary or Administrative Authorities in the presence of two witnesses; he will specify the time within which action must be taken.

Note.—Those who disobey the instructions of the Sanitary or Administrative Authorities will be punished for *desobeissance qualifié* and not only by a fine.

Article 17.—Sanitary orders imposed by competent authority not obeyed within the specified time, will be carried out by municipalities or by Government, at the expense of the offenders without prejudice to the punishment that may be inflicted after trial.

Note.—In cases where this payment is not made voluntarily it will be obtained by force to the amount of the bill of the authority concerned.

Article 18.—All Sanitary Officers will make a large free distribution of quinine-salts for curative and prophylactive purposes. The following prices are fixed for persons able to pay :—

Hydrochloride of Quinine .. per gramme ..	.. 0–01–00
Sulphate „ „ .. „ „ ..	.. 0–00–06
Hydrobromide „ „ .. „ „ ..	.. 0–01–00
Bisulphate	.. 0–01–00
Euquinine	.. 0–03–00
Each ampule for injection will cost	.. 0–01–00

in addition to the price of the substances employed. Manipulation of all these salts of quinine will be free :—

Each cachet	.. 0–00–03

Article 19.—Complete compliance with these regulations must be made within a maximum period of twelve months, from the date of publication of this decree : for the places named in Article 1 this time is reduced to six months.

Article 20.—The Head of the Sanitary Service and the Sanitary Board should periodically supervise the general execution of the sanitary measures referred to in these regulations, making inspections of sanitary districts that they may be able to judge of the manner in which these measures are being carried out and form an opinion of municipal bye-laws so far as these concern public health. Clear and concise reports should be submitted to Government through the Board of Health, detailing the measures that have been adopted, those that have not, the reasons for their non-adoption, everything in fact which can help Government to punish offences and remedy irregularities encountered in the complete execution of the sanitary measures referred to in this present decree.

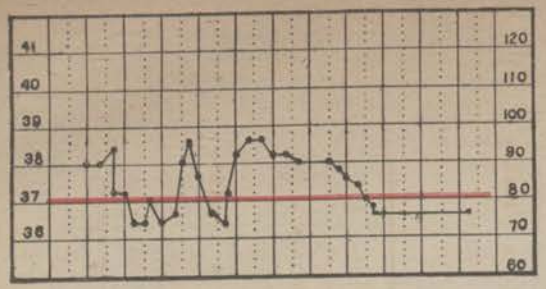
Article 21.—All demands against the execution of these measures will be disposed of within a maximum delay of two months, by the various Committees, the Board of Health or the authorities to whom these demands may be submitted.

Article 22.—The Board of Health will publish in simple language in Portuguese, Concanim and Mahrattah, an account of the manner in which malaria is carried, with a description of mosquitoes and their larvæ, illustrated in colour, with the idea of stimulating an energetic, popular campaign against malaria.

TABLE IV.

Year.	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903 ..	..	..	..	..	4,88	28,74	61,58	83,25	91,78	98,89	100,82	102,6
1904 ..	..	..	..	0,33	1,55	62,15	81,75	90,55	100,16	102,37	*m*	*m*
1905 ..	..	..	..	0,10	1,23	27,49	35,71	43,62	50,28	55,17	55,50	*m*
1906 ..	0,28	*m*	*m*	1,28	26,15	59,51	73,23	79,24	82,12	82,44	*m*	*m*
1907 ..	0,71	*m*	*m*	3,43	*m*	19,17	59.32	78,96	84,51	86,49	*m*	86,62
1908 ..	..	..	..	..	..	0,14	17,35	69,75	92,54	102,44	103,5	*m*
1909 ..	..	..	..	..	1,47	28,53	67,16	76,05	84,31	84,68	85,23	*m*
1910 ..	..	..	0,9	*m*	0,99	35,52	48,68	65,50	75,85	80,14	83,08	*m*
1911 ..	..	..	..	1,60	2,15	38,77	79,06	95,53	100,78	102,12	105,60	*m*

CASE No 1.



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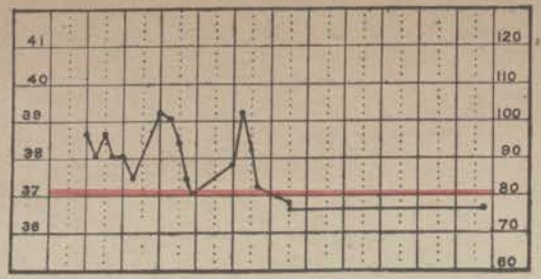

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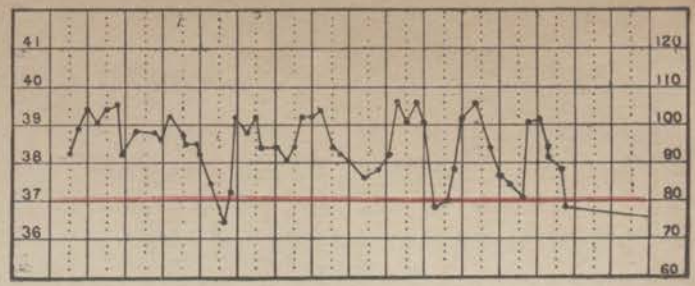

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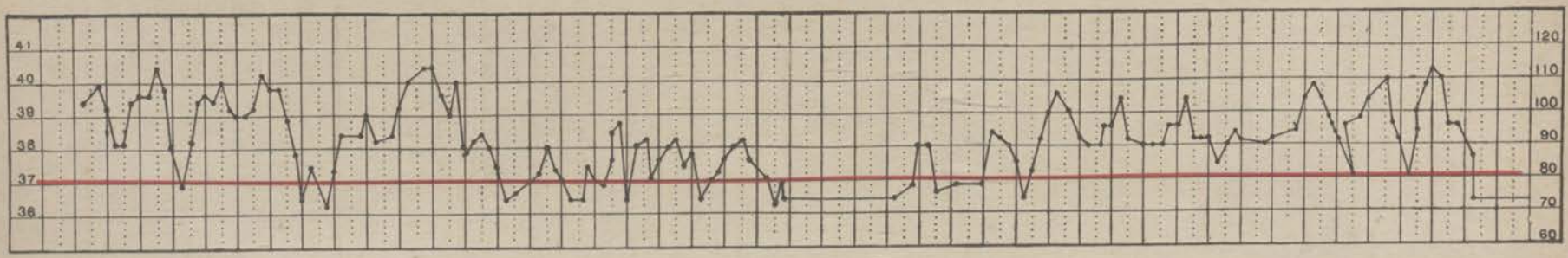

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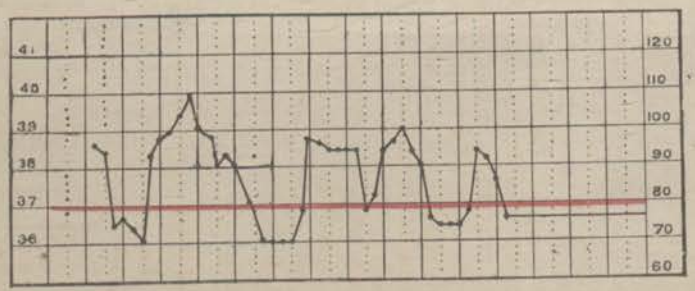

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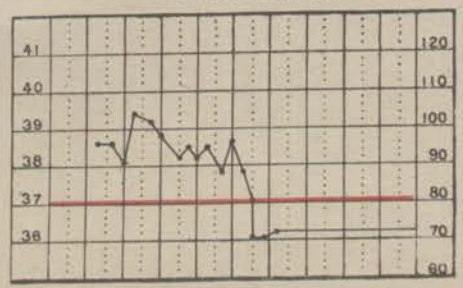

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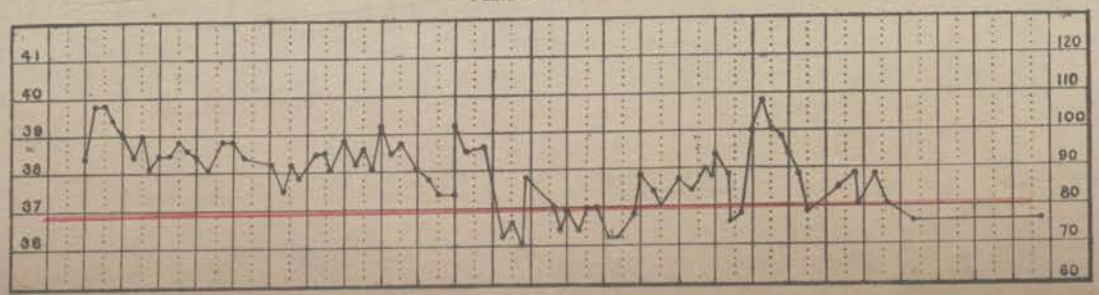

THE SPLEEN RATE IN LONDON SCHOOL CHILDREN.

BY

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THE spleen rate has by almost universal consent been accepted as the most readily and extensively applicable and at the same time reliable measure of the amount of malaria in a community, and has been used almost exclusively in mapping out the varying intensity of malaria over large areas as well as in watching and recording changes and fluctuations in this, whether due to natural causes or following upon anti-malarial measures. It is clear that a test so extensively used and upon which so much is based is worthy of very careful study and that every circumstance connected with splenic enlargement and its detection and measurement should receive the closest attention. In this connection the observations on the spleen rate in London school children now recorded are of some value.

A serious qualification in the use of the spleen rate as a measure of malaria is the fact that other diseases than malaria, very notably kala-azar, produce splenic enlargement and may, to an unknown extent, modify or even seriously interfere with the value of the figures obtained. This is especially likely to be the case where comparatively low spleen rates are concerned and in conditions in which the very existence of malaria at all may be in question.

Again, quite recently in connection with the work of one of us in Cyprus, our observations suggested that an even more serious error might not infrequently arise, especially where the examination for enlarged spleen is very carefully carried out, by taking it for granted that all palpable spleens are enlarged. In other words, we could not feel sure that many normal spleens were not "just palpable."

This possibility was so obviously important that we determined to set the matter at rest at the earliest opportunity by examining a number of children under conditions which quite precluded the presence of malaria. For this purpose, with the consent of the various authorities concerned, the writers of this paper examined nearly five hundred children in five large schools of the North of London. As we had never heard of the "spleen rate" of London having been taken it was a matter of some interest, apart from the above connection, to see what the condition was as regards non-malarious enlargement of the spleen among such children. The results of this examination are given in the following tables :—

TABLE I.

NAME OF SCHOOL.	No. of children shewing palpable spleen.	No. of children shewing (?) palpable spleen.	AGES OF CHILDREN EXAMINED.								No. of children examined.	Percentage of children shewing palpable spleen.
			3 Yrs.	4 Yrs.	5 Yrs.	6 Yrs.	7 Yrs.	8 Yrs.	9 Yrs.	10 Yrs. & over.		
Bayswater Jewish ...	1	2	...	...	5	2	6	3	18	22	80*	
Wilberforce Church of England	1	3	3	24	45	40	35	...	...	...	147	
Great College Street ...	2	...	...	...			27	26	16	1	70	
Marylebone Road ...	...	...	1	5	11	18	3	2	..	...	40	
Barrow Hill Road ...	1	1	8	22	50	44	7	1	..	...	132	
TOTAL ..	5	6	12	51	111	104	78	32	34	23	469	

NOTE.—Twenty-four children were not recorded by age in this batch.

TABLE II.

Shewing Distribution by Age of Palpable Spleens.

AGE OF CHILDREN.	3 Yrs.	4 Yrs.	5 Yrs	6 Yrs.	7 Yrs.	8 Yrs.	9 Yrs.	10 Yrs. & over.
No. of children examined	12	51	111	104	78	32	34	23
No. shewing palpable spleen	...	...	...	1	3	...	1	...
No. shewing (?) palpable spleen	...	1	1	...	1	...	1	1

In making these observations the writers for the most part worked together, a large number of the children being examined by all three and almost all by two of us. Various methods of palpation were tried and various devices as to posture adopted with the object of arriving at the conditions most completely favourable to the detection of the spleen by palpation. One method very successful with children of a certain age, and leading as a rule to very complete abdominal relaxation is for the observer to be seated while the child, standing between the knees, leans slightly forward over his right knee and at the same time looks upward. The observer's right hand is then passed with a light touch under the left lower costal arch of the child.

Five cases of " palpable spleen " were encountered ; the spleen rate among these children was therefore about 1%. In about the same number of cases it was not possible to say with certainty whether the spleen was felt or not. Such cases have been entered in the table as (?) palpable. Even including these very doubtful cases the spleen rate was only about 2%. In none of the children did the spleen extend below the costal margin or exhibit any considerable degree of enlargement and the condition differed strikingly from that encountered in the case of very low spleen rates in India where as a rule the positive cases though few shew distinctly and often markedly enlarged spleens. In the case of the London children, all that could be said of the positive cases was that the spleen was " just palpable."

The observations given shew clearly that no large error due to palpation of the normal spleen has to be considered and a large proportion of " just palpable " spleens in any child community must be considered abnormal and requiring explanation.

In conducting these observations the question of observational error also came up. It was found that in ordinary palpation as commonly practised in the field no likelihood of any serious error arose. In certain postures, however, with very complete relaxation of the abdominal wall and the use of very light palpation a sensation was sometimes obtained as of a normal sized, but palpable spleen. Such impressions were usually momentary and appeared to be due mostly to local reflex contractions of a portion of the abdominal wall muscles which were elicited by the particular method of light palpation employed, but were either not elicited or not appreciated by slightly more forcible palpation. The edge of a muscle or fascia passing down from the last rib, and in one case what seemed to be a small scybalous mass in the colon, also gave impressions which sometimes for a moment suggested a " just palpable " spleen.

An alteration in consistency as well as enlargement would seem to be an important character of the enlarged spleen due to malaria.

NOTE ON THE VALUE OF THE PARASITE-RATE IN THE MEASUREMENT OF MALARIA.

BY

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It might be thought, theoretically at any rate, that the most accurate estimate of the prevalence of malaria in any community would be furnished by an examination of the blood of every individual and by the determination of the number of persons in whose blood malaria parasites or other undoubted evidence of recent malaria were present.

But this method is not often practicable on a large scale and, even if it could be carried out, it is open to objection since the parasites may be temporarily absent or they may be present in such small number at the time of the examination as to escape detection. A further fallacy would arise if quinine, even in inadequate doses, was being taken by any large proportion of the community. Lastly, malaria exhibits a well-marked seasonal prevalence so that the parasite-rate varies very considerably at different seasons of the year.

In practice, therefore, there is no doubt that the spleen-rate, which is both more easily ascertained and less subject to seasonal fluctuation, furnishes a more reliable estimate of the prevalence of malaria in a community. The information yielded by blood examinations is however of some value, more especially when it is considered along with the spleen-rate.

THE PARASITE-RATE IN AMRITSAR.

In November 1913 the parasite-rate of Amritsar City and environs was estimated as part of a malaria survey of that city. The results illustrate both its uses and its limitations as an index of the amount of malaria in a community.

The spleen-rate at the time was 17 per cent. calculated from 3,475 children between the ages of two and twelve years. The degree of enlargement of the spleen was recorded on the following plan :—

Spleens not palpable were considered normal.
Spleens reaching up to one finger's breadth below the costal margin were called class I.
Spleens reaching two fingers' breadth below the costal margin were called class II.
Spleens reaching three fingers' breadth below the costal margin were called class III.
Spleens reaching four fingers' breadth below the costal margin were called class IV.
Spleens reaching as far as the umbilicus were called class V.
Spleens extending to the pelvis were called class VI.

The parasite-rate in Amritsar was calculated from films taken as far as possible evenly throughout all parts of the city, with the following result :—

TABLE I.

Area.	No. of films examined.	Positive.	Negative.	Parasite-rate	Spleen-rate.
				Per cent.	Per cent.
Amritsar city and environs, November 1913 ..	270	34	236	12·5	17

In February 1909 Major Christophers found the following relationship to exist between the parasite and spleen-rates in certain areas of Amritsar :—

	Spleen-rate.	Parasite-rate.
	Per cent.	Per cent.
Lakhar Mandi and Mahan Singh	90	66
Subanian	66	58
Chauk Pasian I	13	20
Chauk Pasian II	37	34
Hathi Gate	47	50
Kanyan I	37	43
Kanyan II	54	50
Hakiman	93	72

The total spleen-rate of the city at the time was 63·4 per cent. Thus, although there is some relationship between the spleen and parasite-rates, this is not of a very definite nature and all that it is possible to say is that when the spleen-rate is high, it is probable that the parasite-rate will also be high.

THE SEASONAL PREVALENCE OF MALARIA PARASITES.

In regard to the relative prevalence of the various species of parasites at different seasons of the year the following Table (Table II) shows the figures obtained in November 1913 together with, for the purposes of comparison, those obtained by Major Christophers in the spring of 1909.

TABLE II.

Species.	November 1913.		February—April 1909.	
	Cases.	Percentage.	Cases.	Percentage.
1. Benign Tertian	8	21	78	78
2. Subtertian	27	79	16	16
(1) Rings only	15			
(2) Crescents only	8			
(3) Rings and Crescents.. ..	4			
3. Quartan	..	..	7	7

This table is of some interest, for it shows that, whereas in February 1909 more than three-quarters of the positive films contained benign tertian parasites, in November 1913 the position is reversed and in 79 per cent. of cases the films showed subtertian parasites. Major Graham has noted a similar change in the relative prevalence of parasites in the United Provinces.

In his report on the prevalence of malaria in Kosi in 1910 he gives an interesting table showing the percentage of parasitic infection in Kosi and Saharanpur from which the figures given below are extracted :—

TABLE III.

	Kosi.		Saharanpur 1909.
	September 1910.	December 1910.	
	Per cent.	Per cent.	Per cent.
Benign tertian	26·9	20	59·1
Quartan	7·7	15	18·2
Malignant	65·4	65	22·7

He suggests that the difference between the relative prevalence of benign and malignant infections in Kosi and Saharanpur may be due either to "an initially different type of predominating infection in the two places, or, what is very probable, an elimination of the less resistant benign tertian infection."

This view would at first sight appear to receive confirmation from the Amritsar statistics given in Table II. In connexion, however, with another experiment, the blood of prisoners in the Lahore Central Jail was examined by my assistant, Assistant Surgeon Trilok Chand Nanda, from April to October 1913 and the species of malaria parasite present was noted. I have extracted from his notes the species of parasite found during each month in the positive films and the result is recorded in the form of the annexed chart.

It will be seen that the spring and early summer is associated with the marked relative prevalence of benign infections which reach their zenith in June and thereafter rapidly decline, but never altogether disappear. On the other hand, subtertian infections were scanty until August when a marked increase took place which was partially maintained throughout September and October. The experiment ceased at the end of October, so no further records are available, but the chart serves to suggest that benign and subtertian infections exhibit a marked seasonal periodicity in the Punjab. It seems, therefore, not improbable that blood examinations undertaken in Amritsar in November would show in a majority of cases subtertian infections, whilst in the spring they would show chiefly benign tertian parasites."

This, it is believed, is the explanation of the marked divergence between the relative prevalence in Amritsar of benign and subtertian parasites in the spring of 1909 and in the autumn of 1913. Furthermore, one might hazard a guess that the blood examination carried out in Saharanpur was from films made in the spring, or at any rate not in autumn of 1909.

There is little new in regard to this observation, for in Italy it is well recognised that "spring intermittents" are associated with benign tertian and quartans, whilst the "sub-continued," or "autumnal remittents" are chiefly caused by the æstivo-autumnal or subtertian parasite. Celli uses the above terms and classifies malaria as (1) mild malaria due to "spring quartan and tertian" and (2) severe malaria, as being the result of infection with the æstivo-autumnal parasite.

In India, however, so far as I am aware, the seasonal prevalence of the malaria parasites has not received much recognition. It may be that it is only in Northern India that these seasonal distinctions are marked, and that, as the more strictly tropical zone is reached, where infection and re-infection may occur throughout the year, they become less distinct or even absent.

Finally, this observation serves to emphasise the importance of recording the date of blood examinations whenever a parasite-rate is being determined.

THE EFFECT OF SPLENIC ENLARGEMENT ON THE PARASITE-RATE.

An effort was made to take films equally from children with and without enlargement of the spleen in order to be able to study the effect of an enlarged spleen on the parasite-rate. The result is given in the following table :—

TABLE IV.

Condition of spleen.	No. of films.	No. infected.	Parasite-rate.
			Per cent.
Spleen not enlarged	139	9	6
Spleen enlarged	131	25	19

It is thus clear that 6 per cent. of the children examined whose spleens were not palpable harboured malaria parasites, whilst 19 per cent. of those with palpable spleens had parasites circulating in their blood at the time of examination. A further sorting of the results was made to determine the effect of the *degree* of enlargement of the spleen on the parasite-rate, and the result is recorded below :—

TABLE V.

Size of spleen.	No. of films.	No. infected.	Percentage infected.
			Per cent.
Not palpable	139	9	6
Class I	16	3	19
Class II	37	8	21
Class III	32	3	10
Class IV	31	9	29
Class V	10	1	10
Class VI	5	1	20

These results appear to indicate that when once the spleen is enlarged the degree of enlargement does not appreciably affect the chances of finding parasites in the blood as the result of one examination during a fever-free period. It must, however, be recollected that the "fever season" had recently concluded in Amritsar and it is, therefore, probable that a different result would be obtained if the parasite-rate had been determined a few months earlier.

That 6 per cent. of the children without enlargement of the spleen should show parasites is not remarkable since chronic splenomegaly is produced by repeated rather than by isolated attacks of fever. The low percentage of positive films from children with splenic enlargement of Classes V and VI is striking. It was noted that in a proportion of films from these cases—and but rarely so in others—that microcytes and megalocytes and cells showing polychromatic staining were numerous.

CONCLUSIONS.

(1) As an index of the amount of malaria in a community the parasite-rate is of less value than the spleen-rate.

(2) The benign and subtertian parasites in certain parts of Northern India show well marked seasonal variations.

(3) Whereas benign infections reach their maximum in June, subtertian infections are most prevalent in the autumn.

(4) In view of these seasonal variations the parasite-rate in any community will depend to a considerable degree on the period of the year when the blood examinations are made.

(5) In consequence of the above no definite relationship in Northern India can be expected to exist between the spleen and parasite rates, nevertheless, when the spleen-rate is high, the parasite-rate will usually tend to be high also.

(6) In only 19 per cent. of the children in Amritsar with palpable spleens were malaria parasites discovered in November 1913 and the *degree* of enlargement did not appear to affect appreciably the chances of finding parasites in their blood at this time.

(7) In view, however, of the seasonal variation in the prevalence of malarial parasites no deductions can be drawn in regard to the effect of splenic enlargement on the parasite-rate at any other time.

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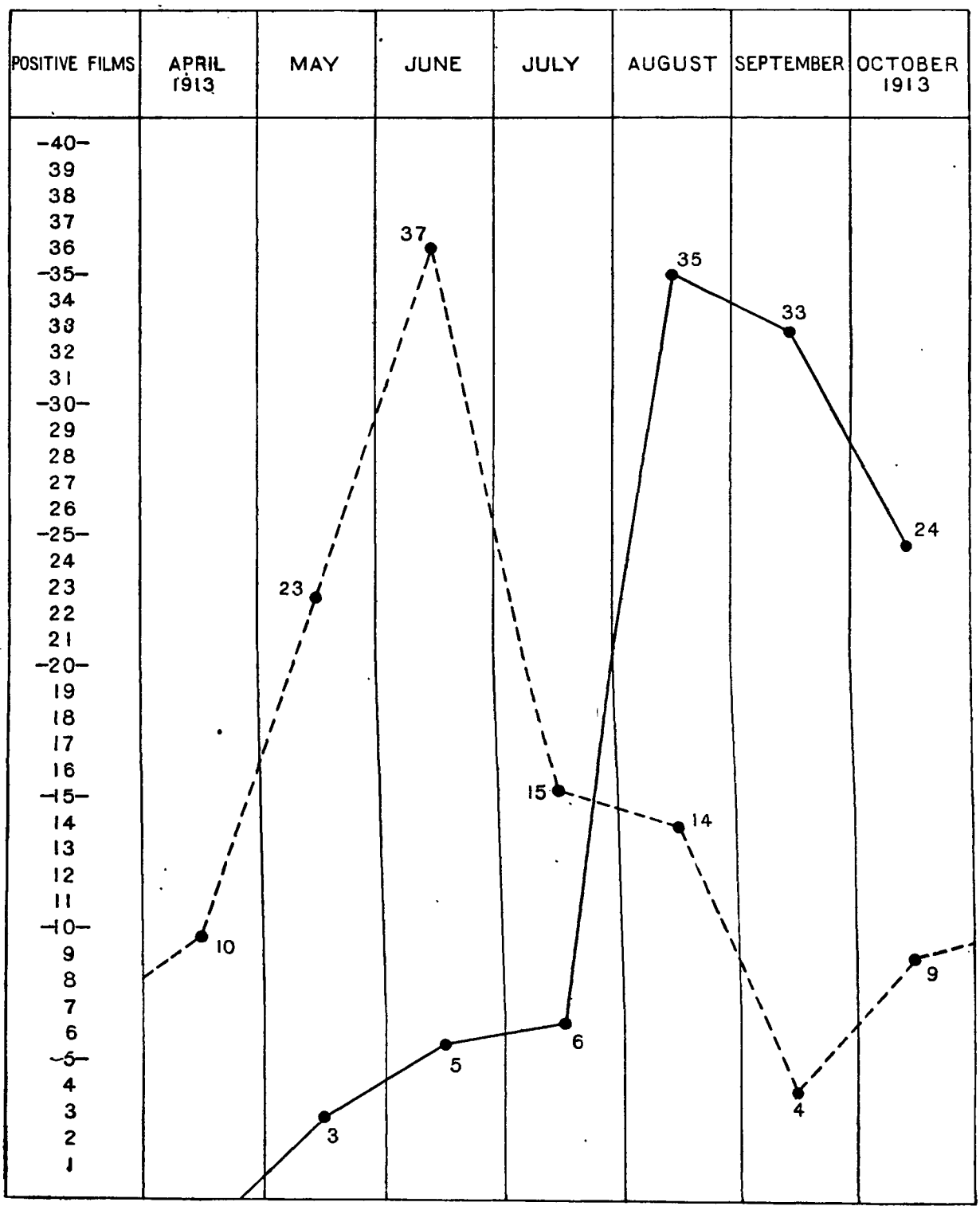
(2) Graham—"An Investigation into the Prevalence of Malaria at Kosi," 1910.

(3) Celli—"Malaria," Longmans, Green & Co., 1900, also article in "The Prevention of Malaria," by Sir Ronald Ross, 1910.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REPORT ON CERTAIN FEATURES OF MALARIA IN THE ISLAND OF SALSETTE.

BY

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GENERAL DESCRIPTION OF SALSETTE.

THE island of Sashthi, or Salsette, lies just north of the 19th parallel of North Latitude on the west coast of India, and close to the mainland. The táluka of Salsette in the Thána District, to which it belongs, and of which it forms all but a strip on the mainland of about 47 square miles, known as the Khairan Patti, is some 250 square miles in extent. Salsette island is separated on the north and east from the mainland by a creek, of which the northern arm is known as the Bassein Creek, and the eastern the Thána Creek. To the south lie Bombay Island and Bombay Harbour. The táluka has a population of some 150,000 people in 140 towns and villages.

Physical Geography and Geology.—The most striking feature of the geography of Salsette island, and one which has a very important bearing on its malariology, is its range of hills, the highest peaks of which are over 1,500 feet, though within a few miles of the sea. This range forms, as it were, the backbone of the island, and runs, diminishing in height, from the northern end southward. In the southern portion of the island is an area devoid of hills, though in the south-east corner, in what is known as the Island of Trombay, at the head of Bombay harbour, there is a hill 1,000 feet in height of the same nature as the hills that run down the centre of the island. Spurs from this main line of hills run westwards towards the sea.

Among the hills lie two artificial lakes, Tulsi and Vehar, which provide part of Bombay's water-supply. A third, Powai Lake, has in more recent times been constructed for the same purpose south of Vehar, though the shallowness of the bed has prevented the water stored from being of a quality that could be used.

The west coast is deeply indented by creeks, the two principal of which are the Malad and Manori Creeks, which detach, or almost completely detach, considerable portions of the land at spring tides.

It is unfortunate that there has never been a geological survey of Salsette. A geological map would have been useful in the present connection, for, as will be seen, there is a relation between the geology of the island and its malariology.

The hills of Salsette are of the same volcanic origin as those of the rest of the Konkan and the Deccan at this latitude. The relative steepness of its hills on their eastern face is as noticeable as in the case of the hills of Bombay Island, and depends on the fact that there is a dip in the strata to the westward of from 10° to 15°, the strata near the coast being, as a matter of fact, of a higher series than those far up in the ghauts. Most of this volcanic rock in Salsette is trap, derived from the lava of ancient volcanoes, but in places the rock is breccia, derived from their ash.

There is certain amount of sedimentary rock to be found, however, especially in the south of the island, where it is continuous with that lying in the bed of what was once a great fresh-water lake, part of which covered areas now in the Island of Bombay.

The soil derived from the disintegration of the trap, which, if it contained more organic matter and were of a darker colour, would be known as a cotton soil, extends from the bases of the hill scarps down towards the sea. By the sides of the creeks it gives place to alluvium which, brought down to the coast by streams, has been washed back by the sea to form the flats that line the creeks of the island and are mostly submerged at spring tides. The alluvium is thus heavily impregnated with salt.

Along the west coast of Salsette are a series of what at one time were sea rocks but which, by the gradual silting up of the creeks by alluvium, are now only separated from the land by the flats. The villages of Bhayandar, Dongri, Uttan, Gorai, Manori, Marva, Malavni, Akse, Yerangal, Marh, Daravli, Vesave, Juhu and Bándra are all built upon islets recently more or less assimilated to the land in this way. In some of those places the trap shows itself and forms considerable ridges. In some it occurs in different stages of disintegration as muram, red earth and even soil on which rice and rabi crops can be grown. In other places any soil that has formed has been obliterated by blown sand, which forms dunes that line the shores opposite some of the villages.

Coincidently with the process of silting up of the creeks there is in progress at some places a process of coast erosion going on which by the end of each monsoon noticeably alters the outline of the shore of certain localities, such as the islet of Juhu, to the North of Bándra.

Climate and rainfall.—There being no observatory on the island of Salsette no record of the temperature is available. The climate of the west coast is very much like that of Bombay, where January has an average mean temperature of 73·9° and May one of 84·7°. In the eastern or inland parts of Salsette the temperature varies considerably with the variations in geographical and geological formation.

In Bombay, as shown by the records of the Colaba Observatory, winds are northerly in November, December, January and February. From the middle of March they begin to change to a westerly direction, and from the beginning of April to the end of September the prevailing direction of the wind is westerly; during the first half of October winds are unsteady and slowly change to a northerly direction. The south-west monsoon breaks in June, is at its height in July and August, and is over early in October. The north-east monsoon occasionally gives showers in November and December.

The following statement gives the total rainfall for the years 1902 to 1911 at Kurla and Thána. The greater precipitation at Thána is due to the influence of the hills of Salsette, which lie between the town and the sea. Even at Kurla the rainfall is slightly greater than at places actually on the coast :—

Year.	Rainfall at Kurla, in inches.	Rainfall at Thána, in inches.	Year.	Rainfall at Kurla, in inches.	Rainfall at Thána, in inches.
1902	77·62	81·17	1907	97·71	105·38
1903	103·62	126·97	1908	82·31	87·6
1904	60·89	91·98	1909	105·04	113·66
1905	43·78	58·32	1910	74·71	82·88
1906	72·22	84·48	1911	54·22	71·92

Trees and crops.—Part of the central hill area is under "forest," the term being used in its technical sense. But almost everywhere, from the hill area right down to the alluvium, the soil of Salsette island supports a growth of trees and long grass, only interrupted by the rice-fields which cover so large an area of the island. Round the villages the commonest trees one finds are the Amb (*Mangofera*), the Chinch (*Tamarindus*), the Sitaphal (*Anona*), the Bhendi (*Thespesia*), the Karanj (*Pongamia*), the Sag (*Tectona*), the Rajan (*Mimusops*), the Bor (*Zizyphus*), the Kaju (*Anacardium*), and, among palms, the Tad (*Borassus*), the Naral (*Cocos*) and the Shindi (*Phœnix*). So near a large city, both the long grass and the produce of many of the trees form a considerable commercial asset. Even the villas that line the Ghodbandar road, near each of the railway stations of the B.-B. & C. I. Railway, from Andheri northwards, and which are at once the hope and the despair of the town-planner, are enveloped in palm or mango-orchards supporting a rank growth of grass.

Prices.—Rice of the second sort is the staple food in Salsette táluka. The following are the rates per rupee from 1901 to 1912 :—

Year.	Seers (80 tolas = 1 seer).	Chattaks.	Year.	Seers (80 tolas = 1 seer).	Chattaks.
1901	10	3	1907	9	4
1902	10	3	1908	7	6
1903	11	2	1909	9	4
1904	10	3	1910	9	2
1905	10	2½	1911	8	2
1906	9	14½	1912	7	5

Population, castes and employment.—The three municipal towns of Salsette are Thána, Bándra and Kurla. Their census population, with that of the rest of the táluka, is given in the following table:—

Name of town or rural circle.	Census of 1891.	Census of 1901.	Census of 1911.
Thána	17,455	15,410	15,591
Bándra	18,317	22,075	22,885
Kurla	11,469	14,831	15,081
Rural Salsette	78,878	94,016	98,895
TOTAL POPULATION OF TALUKA ..	126,119	146,332	152,452

The chief occupation of the rural population is the cultivation of rice, on which not only members of regular agricultural castes but a great many other people are mainly dependent for their livelihood. Though there is only the one crop, and the rice-fields lie fallow for the rest of the year, the various processes incidental to the cultivation and storage of rice seem to provide the average cultivator or field-labourer with work for the year round. A certain amount of market-gardening is done, especially in the coast villages, and in different places timber-felling and carting, grass-cutting, mango-growing, toddy-drawing, sea-fishing and salt and lime working provide the different castes with employment. Though there are a few large mills at Kurla town in the south of the island, there is not the migration for work in the mills of Bombay that is so marked in the sea-coast tálukas of the neighbouring Kolába District.

In rural Salsette there is little of a Musalman population. Of the better class Hindus there are a certain number of Bráhmins and Parbhus. Besides those who more or less definitely follow some one occupation, such as Dhobis, Lohárs, Shimpis (tailors), Mális and Sonárs, and those whose occupation has always been mainly agricultural, such as Maráthas, Pánchkalshis and Dhodyas, there are castes who have more or less deserted their tribal or caste occupations to become occupiers of agricultural land or field-labourers, such as Agris (originally salt-workers), Bhandaris (originally only toddy-drawers), and Dublis and Varlis (originally forest tribes). The population of some villages mainly consists of Kolis, the term Koli being applied to several groups of fishermen and cultivators of mixed descent now classed as Hindus. Mahárs are met with, mostly in their capacity as out-castes and village servants, but also sometimes as well-to-do labourers, and even mechanics.

All along the coast, both in the town of Bándra, and in the villages, a proportion of the population, most unusual for the Bombay Presidency, consists of Indian Christians. These are the descendants of the early converts of the Portuguese. In the villages they are nearly always cultivators, but Bándra town supplies Bombay with a considerable number of its clerks and mechanics. They are rapidly learning English, and becoming more and more Europeanized in their dress. Although their higher standard of living makes them more resistant to malaria than many of the classes among which they live, their villages have at times been severely visited by plague, which has considerably reduced the population in some of them. Moreover, they are fond of showing their independence of the Bráhmin official, and one manifestation of this tendency, consisting of frequent refusal of the services of the vaccinator, renders them peculiarly liable to small-pox.

The Bándra-Dánda Peninsula, and especially the ridge known as Páli Hill, has for long had a considerable European population, consisting mostly of Bombay business men, who go in daily to their offices. Especially since plague established itself in Bombay their example has been largely followed by well-to-do Indian business men, who have built villas round every railway station in Salsette where malaria is not sufficiently bad to make residence quite impossible. Except in the case of some of the stations nearer Bombay, such as Ghátkopar, those villas are not inhabited in the rainy season, nor in the cold weather till it is drawing to a close, the fear of plague, and the desire for fresh air being the main inducements to a semi-suburban or rural life in the hot season.

The matter of these groups of villas, and the desirability of controlling building by the introduction of the principle of town-planning, are fully dealt with in Mr. Mead's Report, and town-planning is now being regulated by a special officer appointed for the purpose by Government.

VITAL STATISTICS.

Till near the end of the decennium 1901 to 1910, Salsette, for the purpose of the compilation of vital statistics, was divided into the Thána Town Circle and the Salsette Rural Circle. Since 1908 Bándra has been dealt with as a separate Town Circle, and it has recently been decided to constitute Kurla as a separate Town Circle from 1913. These separations of the urban from the rural population of

Salsette will enable variations in the intensity of such diseases as malaria, so much more a rural than an urban disease, to be more accurately studied over a period of years in the future than they can be at present.

In 1911 Captain B. Higham, I.M.S., when acting as Deputy Sanitary Commissioner, carried out for the Western Registration District the statistical enquiry ordered in Government Resolution, General Department, No. 4796 of 29th September 1910. He prepared charts for two series of years before and after the outbreak of plague in the Presidency, showing curves for the mean monthly figures for each táluka, of total births, total deaths, and infantile mortality. He discontinued the plotting of curves for still-births before he came to the vital statistics of the Thána District, as he found that the curves for different tálukas of the Násik District showed such a complete lack of conformity as to indicate that no reliance could be placed on the registration of still-births. He also prepared tables showing "epidemic figures," on the lines laid down by Major Christophers. The compilations of Captain Higham, on which his curves were prepared, have been of considerable assistance in preparing the two charts that accompany this present report. Unfortunately, on account of the destruction of certain records, he was not able to obtain his pre-plague figures for a decennium of continuous years. Apparently on account of some difficulty in ascertaining the populations on which some of the ratios should be calculated for this pre-plague series of years, all the curves for the pre-plague series, for births, for total deaths, and for infant mortality, are below the corresponding ones for the post-plague series. It was, accordingly, inadvisable to attempt to draw conclusions based on the differences shown between the several kinds of curves of the two series of years.

For the present report only the vital statistics of the intercensal decennium 1901 to 1910 have been taken. The figures are for the whole of Salsette Táluka, including its urban populations.

The death-rate.—A description of the Seasonal Chart (Chart No. 1) is given on it. The principle followed in the preparation of the lowest curve in it has been that rural registration work, at any rate, is generally accurate as regards the *total* number of deaths, and that if the figures for certain diseases which (1) tend to be seasonal in their incidence, (2) are easily recognized even by ignorant persons, and (3) are not themselves the sequelæ of malaria, are deducted from the total, the residue will give a fair idea of the seasonal variations in mortality due to malaria. A curve showing the death-rate among children under one year, calculated, not on the population, but upon the births, has been shown, both because this is the most accurate of all death-rates, and because it affords a very good indication of variations in the intensity of malaria, infants being extremely susceptible to the disease. Letters and figures showing the normal mean wind direction and steadiness for the day for each month of the year at Colaba (Bombay) Observatory are given at the foot of the chart, as also figures showing the mean monthly velocity of the wind in miles per hour for the year 1911. The "steadiness" is the excess percentage of observations in the direction of the monthly resultant.

It will be noticed that it is towards the end of the year that the total death-rate curve and what we may term the curve of the death-rate, *minus* the rate for special diseases, most closely approach each other, *i.e.*, it is then that there is least of those diseases. Early in the year they begin to diverge, as plague begins to increase, and they remain widely apart for some months, their further divergence from each other in April being due to the super-addition of cholera to plague. The decline of plague after April brings about a rapid fall in the total death-rate, which is not shared to any extent by the infantile death-rate, and a greater approximation of it to the death-rate, *minus* the rate for special diseases. June is seen to be the all-round healthiest month. All the death-rates rise after the monsoon has well set in. The rise is better marked in the case of the total death-rate than in that of the death-rate, *minus* that for special diseases, and more marked still, and earlier marked, in the case of the infantile death-rate. Here cholera, and diarrhœa and dysentery are in operation. Their decline in September and October with the dying away of the monsoon, and the approximation again of the two lower curves to one another, can be seen at a glance.

Malaria not being a disease that kills very rapidly, though it is accountable for so great a proportion of the deaths that do occur, it is not till the malaria season is well established that its effect on the mortality is marked. In October there is slight rise in the death-rate *minus* the rate for special diseases, but in the case of the other two death-rates any rise due to commencing mortality from malaria is concealed by the fall in the mortality from diseases of the bowel. But in November the rise is very evident in all the death-rates; and, at a time when, as seen by the maximum approximation of the two lower curves on the chart to one another, there is less mortality from the special diseases taken together than at any other time of year, infantile mortality is actually at its highest, because of the severity of malaria

at this season. In infants malaria kills much more quickly than in adults, and less often through late complications, such as pneumonia. This is probably the reason why the infantile death-rate is already falling in December and January from the maximum in November, while the death-rate, *minus* the rate for special diseases, remains high, and actually reaches its maximum in January.

The continuous fall of this latter death-rate throughout the latter part of the dry season affords the best indication of the continuous decline that goes on then in the amount of malaria. The curve for this death-rate certainly accords with the account the cultivators themselves give of malaria, that it is essentially a disease of the cold weather months, and that it is not till the warm weather commences that the country begins to be healthy. It is with the fall of this curve that the country residences of well-to-do Indians in Salsette begin to be occupied.

It will be noticed that it is in October that the wind is just changing round to the north, from the west, before beginning to blow steadily from the north in November, and that the reappearance of the westerly element in March synchronizes with the commencement of this steady fall in the mortality that has been noted. This may be otherwise stated by saying that the absence of the sea-breezes coincides in point of time with the greater mortality from malaria.

A description of the yearly chart for the intercensal decennium 1901 to 1911 (Chart No. 2) is given on it; it includes a curve for the variations in rainfall. The appearance of the curve showing the total death-rate, *minus* that for special diseases, does not suggest that the death-rate from malaria has shown any general tendency to increase during the decennium. Nor does it suggest that there was any very severe epidemic visitation of the disease. But it does show clearly two facts regarding the relation of malaria to the rainfall that have been noticed in other parts of India. One is that a mere heavy rainfall does not of itself involve any necessary increase in the amount of malaria. In the year 1909 the rainfall was over 113″, and in 1903 it was 127″, yet no marked rise in the amount of malaria appears to have resulted in either case. The other well-known fact illustrated by this chart is that what does cause a marked rise in the incidence of malaria is the occurrence of a year of defective rainfall followed by one of ordinary or even of rather less than ordinary rainfall. The most malarious year of the decennium was 1906, the rainfall for 1905 having been so extraordinarily low, for Thána, as to be little over 58″.

Hitherto variations in the incidence of endemic malaria have mainly been studied; it remains to be seen whether the figures do or do not give an indication of the occurrence of waves of epidemic malaria, such as have been shown, by a study of mortality figures, to have occurred in the Punjáb. This is best shown by taking the mean of the deaths recorded throughout the decennium for some month which seems to have been free from special epidemic conditions, treating this figure as one, and subjecting the mortality figures for the different months of the different years to division by it, in order to see whether a high multiple of one is anywhere obtained.

In the following table the deaths for the different months of the different years of the decennium, less the deaths from the special diseases, are given, those figures which are less than 10 per cent. above the mean of their particular month having been expunged, to show up the others more clearly:—

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Years
1901	432	420	425	..	..	..	..	..	..	..	..	..	1901
1902	..	..	..	..	..	..	..	..	344	364	389	449	1902
1903	445	391	..	359	..	250	..	..	..	..	..	..	1903
1904	..	..	..	..	..	249	..	..	..	..	..	..	1904
1905	..	360	..	332	295	258	..	..	..	..	..	..	1905
1906	..	..	439	361	337	288	333	386	..	350	407	384	1906
1907	..	..	..	..	..	..	..	..	..	..	..	..	1907
1908	..	..	..	..	..	..	..	351	..	..	..	..	1908
1909	..	..	..	..	..	..	..	..	..	..	..	..	1909
1910	..	..	..	..	..	..	..	..	..	351	409	384	1910

June being the month in which the death-rate, *minus* the rate for special diseases, is lowest, its mean for the decennium may be taken as one. In the next table the figures for the first table have been corrected so as to be figures for months of thirty days. They have then been divided by the mean of the figures for June, and the result is as shown. The figures for the rainfall at Thána for the years of the decennium have been inserted at the left hand side of the table, the rainfall for 1899 and 1900 also being given:—

Rainfall at Thána, in inches.	Years	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Years.
41·87	1899													
86·61	1900													
100·74	1901	1·8	2	1·8	..	..	..	..	..	..	..	..	..	1901
81·17	1902	..	..	..	..	..	..	..	..	1·5	1·6	1·7	1·9	1902
126·97	1903	1·9	1·9	..	1·6	..	1·1	..	..	..	..	..	..	1903
91·98	1904	..	..	..	..	..	1·1	..	..	..	..	..	..	1904
58·32	1905	..	1·7	..	1·5	1·3	..	..	..	..	..	..	..	1905
84·48	1906	..	..	1·9	1·6	1·4	1·3	1·4	1·7	..	1·5	1·8	1·6	1906
105·38	1907	..	..	..	..	..	..	..	..	..	..	..	..	1907
87·65	1908	..	..	..	..	..	..	..	1·5	..	..	..	..	1908
113·06	1909	..	..	..	..	..	..	..	..	..	..	..	..	1909
82·88	1910	..	..	..	..	..	..	..	..	..	1·5	1·8	1·6	1910

Nothing that could be called an actual epidemic figure is to be seen, and it may be concluded that, although variations in the intensity of malaria did occur, malaria did not visit Salsette in epidemic form during the decennium.

It will be observed that the highest mortality occurs early in 1901, the effect of the failure of the rains in 1899 having been to make the malaria season of 1900-01 an unusually severe one.

The birth-rate.—The seasonal birth-rate curves for all the nine tálukas of the Thána District show the same variations for different months. Although rural Salsette so much resembles the average táluka of the Thána District, its curve shows the seasonal variations to a much less degree than the others, probably on account of its being almost the only táluka with anything of an urban population. Accordingly, the birth-rate curve of Salsette Táluka is not shown in either of the two charts. The seasonal birth-rate of rural Salsette is probably really better represented by the curves for the other tálukas. In Captain Higham's charts for the decennium 1901—1910 those all show a continuous rise from between 24 and 34 per thousand per annum in February to between 44 and 58 in May. This high birth-rate is maintained in June, but there is a rapid and a uniform decline to between 32 and 39 in July. There is some further almost uniform decline in September, nearly all the tálukas having then a birth-rate of 28 to 32 per thousand per annum. With a slight but nearly uniform rise in November, and an exactly corresponding fall in December, the rates remain about the same level till the beginning of the rise after February. The Peint Táluka of the Násik District, which is geographically a part of Thána District, shows this same peculiar curve, which is not that of the other tálukas of the Deccan district of Násik, and which is not accounted for by any seasonal migration of the population, for none takes place in Thána District.

This relatively great height of a birth-rate, the mean of which, 34·21 per 1,000 for the decennium, is not high for an Indian district, in the months of March to June, would appear to connote a relatively increased virility in the months of June to September. As the phenomenon is not observed in the Deccan, it must depend on something which influences the Konkani to a much greater extent than the Deccani.

There is one thing that the inhabitant of the Deccan knows little of, and that is the extraordinary difference which the presence or absence of the sea-breeze makes to the vitality of the inhabitant of the Konkan. If a reference is made to the meteorological figures at the foot of Chart No. 1 it will be seen how closely this period of relative virility coincides with the monsoon, how it suddenly begins with the access of velocity in the sea-breeze in June, and the appearance of the southerly element, and how it ends as abruptly in October when the wind shifts round from the west to the north and the malaria season sets in.

THE ANOPHELINE MOSQUITOES OF SALSETTE.

The following are the species of anopheline mosquitoes which were found in Salsette during the present enquiry :—

Myzomyia culicifacies.	*Nyssorhynchus jamesii.*
Myzomyia listoni.	*Pyretophorus jeyporiensis.*
Neocellia stephensi.	*Nyssomyzomyia rossii.*
Nyssorhynchus fuliginosus.	*Nyssomyzomyia punctulata.*

Myzorhynchus barbirostris.

It will be noticed that these are the same anophelines as those found on Bombay Island by Dr. Bentley, with the addition of *Py. jeyporiensis* and *N. punctulata.*

In Appendix I is given a table in which the anophelines are mentioned one by one, with the exact places where they have been found in the larval or adult state within the boundaries of the different villages, the latter being grouped according to the nearest railway stations.

In Appendix II another table gives the villages in alphabetical order, with the names of the different species, and the places in which they have been found. From both of those tables the record of *N. rossii* has been omitted.

It is hoped that this will facilitate any research that may in future be carried out in order to discover which mosquitoes are the actual carriers.

In Appendix III notes are given on the apparatus used in collecting larvæ, and on the instructions issued to subordinates employed to collect them.

The first four of the anophelines mentioned have been found, in one part of India, or another, to be carriers of malaria.

The following table gives the proportion of adults captured and brought for identification from the east and from the west side of the island respectively, out of a total of 823 from the east side, and of 1,168 from the west side. It will be noticed how closely the two sets of percentages resemble one another :—

Names of species.	East side.		West side.	
	Number caught.	Percentage of total.	Number caught.	Percentage of total.
Py. jeyporiensis	..	..	1	·08
N. punctulata	4	48	..	..
Ny. fuliginosus	57	6·93	97	8·30
My. culicifacies	4	·48	2	·17
Ny. jamesii	2	·24	1	·08
My. listoni	4	·48	2	·17
M. barbirostris	23	2·80	26	2·22
Ne. stephensi	6	·73	2	·17
N. rossii	723	87·85	1,037	88·78
Total ..	823	..	1,168	..

The next table gives the proportion of the samples of larvæ of different species brought from different parts of the island, out of a total of 522 samples identified. As many as possible of the bottles of larvæ were kept standing in order to let the adults hatch out, scores of bottles being accordingly stocked for issue :—

Names of species.	Samples.	Percentage of total.
Ny. fuliginosus	145	27·78
N. rossii	115	22·03
My. culicifacies	93	17·82
Ny. jamesii	19	3·63
My. listoni	36	6·6
M. barbirostris	111	21·26
Ne. stephensi	3	·57

The figures for the larvæ are a much less reliable guide than those for the adults to the actual extent to which different species infest the island. The proportion of specimens of *N. rossii* larvæ found, for example, varies with the weather very greatly. A few weeks of dry weather is sufficient to cause their almost complete disappearance, and a single shower of rain to cause their re-appearance, at some places in every puddle or hoof-print.

It was unfortunate for the enquiry that the monsoon stopped unusually early, at the very beginning of September, as this made it impossible to conduct a really representative examination of the larvæ of the rice-fields.

Wells.—The larvæ of six species, three of which, *My. culicifacies*, *My. listoni* and *Ny. fuliginosus*, are known carriers of malaria in one part of India or another, were found in wells. The number of wells actually examined was not recorded, but, roughly speaking, two wells out of every three were found to contain the larvæ of one or more anophelines. Leaving out of consideration the wells in which the larvæ of *N. rossii* were found, and counting a well as one, two or three according to the number of species found in it, the following figures were obtained :—

Names of species.	Number of wells in which found.	Percentage of total.
M. barbirostris	54	33·75
Ny. fuliginosus	27	16·87
My. culicifacies	55	34·37
My. listoni	19	11·87
Ny. jamesii	5	3·12

Borrow-pits.—The borrow-pits of the B.-B. & C. I. Railway also deserve special mention, as they continue to breed mosquitoes very late in the season, and long after most other temporary breeding-places have dried. Moreover, there is a chain of them running through the most malarious part of the country through which the line runs. A special re-examination of them was undertaken late in October, there having been practically no rain since the beginning of September. Larvæ were brought on this occasion from 55 borrow-pits. Excluding 9 of them, in which only the larvæ of *N. rossii* were found, the proportion in which those of different anophelines were found was as follows :—

Names of species.	Number of borrow-pits in which found.	Percentage of total.
Ny. fuliginosus	40	86·95
M. barbirostris	4	8·69
My. culicifacies	2	4·35

Notes on different anophelines.

My. culicifacies.—The larvæ of this species were found in a great proportion of cases in wells. They were also found in streams, and would have been oftener were there more permanent streams in Salsette. They were also found in railway borrow-pits and rice-fields. A very few adults were found in huts.

The larva is stated in James and Liston's "*Anopheline Mosquitoes of India*" to have fully developed palmate hairs on the thorax. The present writer's experience, in several districts of this Presidency in which he has hatched out mosquito larvæ at different places, has been that palmate hairs are rarely found on the thorax in this species, and certainly never fully-developed ones. This is unfortunate, for it means that the larvæ of one of the principal malaria-carriers of the west of India have to be put in the class whose characteristics are mainly negative.

My. listoni.—The larvæ of this species were also mostly found in wells. A few adults were found in cowsheds and other buildings.

In the standard description of this mosquito, given in *James and Liston*, the 3rd longitudinal vein of the wing is said to be white-scaled, this being one of the principal distinguishing characteristics, as this vein in the case of *My. culicifacies* is black-scaled. Dr. Bentley, however, states in his report that in the variety of *My. listoni* present in Bombay this vein is black-scaled. In Salsette, both in the case of adults caught in houses, and in the case of those hatched out from larvæ, the 3rd longitudinal vein of *My. listoni* was found to be white-scaled. This and the fact that the first dark area on the costa of the wing is not, as in the case of *My. culicifacies*, divided into two by a white spot, made it quite possible to distinguish *My. listoni* from the other, without having recourse to comparison of the relative length of wing-cells, as has been recommended.

Dr. Bentley further states that the larvæ of *My. culicifacies* are indistinguishable from those of *My. listoni*. There are species the larvæ of which may be difficult to distinguish from those of *My. culicifacies*, but as far as Salsette specimens go, the larvæ of no two species are easier to tell from one another than those of *My. culicifacies* and *My. listoni*, the appearance of those of the latter, with the large palmate hairs on the thorax and the abdominal palmate hairs conspicuously prominent at the sides of the segments, exactly corresponding with the illustration given in *James and Liston*.

Like *My. culicifacies*, *My. listoni* was not found to be the carrier by Dr. Bentley in the case of the limited number of specimens of adults caught in Bombay Island and dissected, during his investigation. In parts of Bengal it is the chief carrier of malaria, but it has not, so far, been found infected in Western India.

Veocellia stephensi.—This species, which is the carrier in the case of Bombay, is noted by Dr. Bentley as being scarce in the northern and non-malarious part of Bombay Island. In the Thána District, outside Salsette, the writer has found its larvæ in a nullah near Kalyan, and in the stream running into the creek at Bhiwandi just above the tidal limit. The present investigation has shown it to be so very scanty in Salsette that it is extremely unlikely to be the carrier of the malaria which is so common over a large area of that island.

Ny. fuliginosus.—This is the tank-breeding mosquito *par excellence*. It is found in practically any tank one cares to examine in the Thána District It is also the mosquito most commonly found in rice-fields and railway borrow-pits. Next to *N. rossii* it is the commonest mosquito in houses in Salsette. It is mentioned by Dr. Bentley as having been once found in Bombay.

In Burma and in Northern India this species has been found in some places to be the principal carrier of malaria. Its ubiquitousness in Salsette makes it difficult

to hazard a guess as to whether it is likely to be a carrier there or not : that it breeds in numbers in non-malarious villages does not necessarily mean that it is not a carrier in malarious ones.

Ny. jamesii.—This is the species which seems to replace *Ny. fuliginosus* in Bombay Island, where it is very much commoner as a tank mosquito than in Salsette. It is distinguishable from *Ny. fuliginosus* in having speckled legs, and also by having certain differences in the scale markings of the veins of the wings. Even at a glance it is possible to tell the one from the other by the fact that *Ny. fuliginosus* gives the impression of having a dark wing with white spots, *Ny. jamesii* of having a light wing with black spots.

This mosquito is capable of being experimentally infected in the laboratory, though it has not been found infected in nature. It does not occur sufficiently commonly in Salsette to make it likely to be much of a carrier in any case.

Pyretophorus jeyporiensis.—This is not a widely-distributed species. Only one specimen, an adult, was found in Salsette. Its markings were as described in *James and Liston.*

Nyssomyzomyia rossi.—This is infinitely the commonest of the anopheline mosquitoes. Though its breeding-places are such as rapidly dry up at the end of the monsoon it was, as usual, present in houses and cowsheds in such numbers as very seriously to interfere with the collection of more important species. Neither in Bombay, where Dr. Bentley dissected large numbers of specimens, nor in other places has this, the first described of the anophelines, been found to be infected. Were it a carrier hardly any one would escape malaria.

Nyssomyzomyia punctulata.—This species is easily told from all other anophelines by its having half the proboscis black, and the other half white. Adults were found in a few places in the eastern side of the island. No description of its larvæ has as yet been published, and it was not found to hatch out from any of the samples of larvæ brought for identification in Salsette.

Myzomyia barbirostris.—This mosquito is the third commonest in the houses and cowsheds of Salsette, and its larvæ are by far the commonest in the wells. It has a great preference for dark, shady places. It has been infected experimentally, but has not, so far, been found as a carrier in nature.

General Conclusions.—In the absence of dissection of captured adult mosquitoes, to discover which are the carriers, it cannot be said that any definite indication can be found from a study of the distribution of anophelines in Salsette. Mosquitoes there are, which have a definite reputation elsewhere as carriers of rural malaria, but they are to be found in places that, as tested by the spleen census, are quite free from malaria, as well as in places notoriously subject to it, and the carrier of the urban malaria of Bombay is very scarce in Salsette.

Whatever be the carrier, it is evident that something more than the presence of facilities for breeding in abundance is required. The presence of sufficient dampness and shelter from the wind to enable the female to survive in considerable numbers till she becomes infected, and, further, until the parasite has gone through that part of its cycle which takes place in her body, and is present in her salivary glands, appear to be the factors which must be present to determine the malariousness of a locality.

The Spleen Census.

The percentage of indigenous children showing enlargement of the spleen, a condition rarely due in childhood to any other cause, has been found to be a most excellent means of judging of the extent to which malaria prevails in a community.

In working out the malariology of an area sufficiently limited to be dealt with completely, the taking of the spleen rate, as it is called, is only one of a number of means of study. But the spleen census by itself gives results so accurate and so rapidly obtainable that when it is merely a case of finding out whether a given tract of country is malarious or not, or of judging of the relative malariousness of different parts of one, it is neither practicable nor necessary to combine with it any other means of demonstrating the amount of malaria present. A spleen census among children has accordingly been used as the best method of demonstrating the great variations which exist in the extent to which the different parts of Salsette are affected by the disease.

The accompanying map of the island of Salsette shows the percentage figure of the spleen rate marked in under the name of each town or village. In order to show more graphically the wide differences that exist between different places in respect of malaria, different colours have been used. Figures up to 10 per cent. have been entered in green ; those up to 25 in orange ; those up to 50 in brown ; and those above 50 in red.

It is an obvious possible use of this map to take its figures as a guide in making out another map, showing the whole island marked out in patches of colour, according to their relative malariousness or non-malariousness, in order to assist those

who have to judge of where to build and where not to build. But the *boundaries* of such coloured areas would be very difficult to determine in any reliable manner, and the more so in those very parts where malaria has so thinned the population that the means of taking a representative spleen census are absent. It is better not to attempt to make the figures show more than they do show, and to trust to the general lessons they teach for guidance, in areas where they do not give detailed information.

While the spleen rate is not influenced by the severity or otherwise of a particular malaria season to anything like the same extent as an endemic index consisting of the percentage of children found to harbour the malarial parasite in the blood, it is only to be expected that good and bad years should make some difference in it. It is well at the outset to note, then, that the year 1911, which is the one whose malaria season would exercise the greatest influence on the spleen rate taken in 1912, was a distinctly mild fever year, as the season of 1912 promises to be also, so that the figures certainly do not over-estimate the extent to which malaria prevails in Salsette.

The following table gives in alphabetical order the towns, villages and hamlets in which the spleen census was taken. In the case of the villages round Thána, it was taken by the writer in December 1911, in the course of an investigation carried out in order to find out if any part of the environs of Thána was sufficiently non-malarious to allow of the building of residences for district officers. Here the spleens are not classified according to size. In the case of the villages and towns of the rest of the island, in which the spleen census was taken in October and November 1912, as part of the special investigation which is the subject of this report, they are classified according to the method recommended by the Central Malarial Committee. In all 7,156 children were examined :—

Village or Hamlet.	Place on map.	Size of spleen in children examined.					Total of children examined.	Spleen rate per cent.
		Spleen not enlarged.	Spleen just palpable.	Spleen 2—3 fingers' breadth below ribs.	Spleen a hand's breadth below ribs.	Spleen extending down to navel.		
Aksa	12 — C	17	..	..	..	..	17	*Nil.*
Ambivli	15 — E	84	1	..	2	1	88	4·5
Andheri	16 — E	71	1	1	..	..	73	2·7
Anik	23 — H	28	4	3	1	2	38	26
Babhai, Hamlet of Eksar..	8 — F	73	7	7	..	..	87	16
Balkumb	9 - N	Spleens not classified.			..	..	65	22
Bamanwada	17 — F	20	..	..	..	..	20	*Nil.*
Bándra-Dánda Peninsula ..	19 — E	1,000	..	1	..	..	1,001	0·09
Bhandup	14 — L	78	15	15	3	1	112	30
Bharodi, Hamlet of Pahadi.	13 — E	14	1	3	2	..	20	30
Bhatti, Hamlet of Bhandup	13 — K	3	4	16	5	3	31	90
Bhayandar	3 - E	110	1	..	..	1	112	1·78
Bombay Refuse Depôt ..	20 — I	41	..	..	..	..	41	*Nil.*
Borla	21 — I	35	1	3	..	..	39	10
Borivli	8 - E	54	..	6	..	..	60	10

Village or Hamlet.	Place on map.	Size of spleen in children examined.					Total of children examined.	Spleen rate per cent.
		Spleen not enlarged.	Spleen just palpable.	Spleen 2—3 fingers' breadth below ribs.	Spleen a hand's breadth below ribs.	Spleen extending down to navel.		
Charkop	10 — C	75	..	..	..	..	75	*Nil.*
Charai, Hamlet of Chembur	21 — H	67	..	5	..	..	72	7
Chembur	20 — I	141	3	3	1	..	148	4·2
Dahisar	6 — F	57	5	9	2	..	73	22
Dahisar Hamlets	7 — G	4	11	23	8	..	46	91·3
Dánda—see Bándra-Dánda Peninsula	19 — D	..	..	..	..	..	..	..
Daravli	13 — C	12	..	1	..	..	13	7·7
Devi, Hamlet of Magatna..	9 — G	8	3	2	2	..	15	46·6
Devnar	21 — J	51	..	..	2	..	53	3·7
Dhokale, Hamlet of Balkumb.	8 — N	Spleens not classified.			..	..	35	93
Dongri	4 — C	74	..	..	..	..	74	*Nil.*
Gavhan, Hamlet of Mulund	12 — M	Spleens not classified.			..	..	50	40
Gavhan, Hamlet of Mahul	23 — I	6	5	6	2	2	21	71
Ghátkopar, Forest Tribes	18 — I	6	2	7	4	3	22	72·7
Ghátkopar, Commercial Castes.	19 — I	109	6	..	..	..	115	5·2
Ghodbandar	4 — H	69	3	14	1	1	88	22
Gorai	8 — A	163	1	..	1	..	165	1·2
Gundavli	16 — F	12	1	1	..	1	15	20
Hariali	15 — J	4	2	8	3	..	17	76·5
Ingal Khind, Hamlet of Marol.	15 — H	2	3	5	2	..	12	83·3
Iravli	13 — O	Spleens not classified			..	..	37	64
Itawa	11 — O	Spleens not classified.			..	..	66	24
Juhu	17 — D	116	..	..	..	..	116	*Nil.*
Kakda, Hamlet of Magatna	8 — G	6	6	9	4	..	25	76
Kalva	10 — O	Spleens not classified.			..	..	27	15
Kalva, Hamlet of Gorai ..	8 — A	40	..	..	..	..	40	*Nil.*
Kandivli	10 — E	92	4	3	..	..	99	7
Kanheri	8 — F	18	..	3	3	1	24	25

Village or Hamlet.	Place on map.	Size of spleen in children examined.					Total of children examined.	Spleen rate per cent.
		Spleen not enlarged.	Spleen just palpable.	Spleen 2–3 fingers' breadth below ribs.	Spleen a hand's breadth below ribs.	Spleen extending down to navel.		
Kanjur	15 — K	6	5	12	9	3	35	83
Kashi	5 — H	43	12	18	2	..	75	43
Khari	3 — F	Spleens not classified.			..	..	90	30
Kharodi, Hamlet of Malavani	10 — D	41	..	..	..	..	41	*Nil.*
Kirol	19 — I	56	16	7	1	1	81	30
Kalori	8 — E	20	..	..	..	..	20	*Nil.*
Kolhe Kalyan.. ..	19 — F	179	..	..	2	..	181	1·1
Kolshet	7 — O	Spleens not classified.			..	..	44	84
Kondivate	16 — G	5	..	2	..	..	7	71·4
Kurla (new)	20 — H	128	1	1	..	..	130	1·5
Kurla (old)	19 — H	103	..	3	..	..	106	2·8
Mahn Budruk	22 — X	8	2	10	1	2	23	65
Mahn Khurd	21 — K	51	2	4	..	..	57	11
Mahul	23 — H	67	2	6	..	..	75	11
Malad	11 — H	209	2	18	..	..	229	9·5
Malavan	10 — C	88	..	..	..	..	88	*Nil.*
Mandala	21 — K	23	3	3	..	..	29	20
Manjivda	9 — N	Spleens not classified.			..	..	37	43
Manori	10 — B	209	..	..	..	..	209	*Nil.*
Manpada Hamlets ..	8 — N	Spleens not classified.			..	..	40	90
Maravli	21 — H	33	1	2	1	..	37	11
Marh	14 — B	45	..	..	..	..	45	*Nil.*
Marol	16 — H	106	3	8	1	1	119	10
Marve	11 — C	36	..	..	..	..	36	*Nil.*
Masha, Hamlet of Kashi ..	5 — H	6	3	12	2	1	24	75
Mira	5 — G	52	10	15	3	3	83	37
Mhataryatsapada, Hamlet of Ambivli ..	15 — E	9	1	2	..	..	12	25
Mulund	12 — L	Spleens not classified.			..	..	11	64

Village or Hamlet.	Place on map.	Size of spleen in children examined.					Total of children examined.	Spleen rate per cent.
		Spleen not enlarged	Spleen just palpable.	Spleen 2—3 fingers' breadth below ribs.	Spleen a hand's breadth below ribs.	Spleen extending down to navel.		
Nana, Hamlet of Mulund.	13 — L	Spleens not classified.			..	..	28	71
Navghar, Hamlet of Mulund	13 — M	Spleens not classified.			..	..	49	33
Navpada	11 — M	Spleens not classified.			..	..	26	77
Naytodi, Hamlet of Eksar	8 — E	19	1	..	..	..	20	5
Pahadi	13 — E	11	4	5	..	2	22	50
Pali, Hamlet of Dongri ..	4 — B	34	2	..	..	..	36	5·6
Poisar	9 — E	69	10	7	3	1	90	23
Raimurda ..	4 — D	158	..	1	..	..	159	0·6
Santa Cruz	19 — E	64	..	..	..	..	64	*Nil.*
Shahad	17 — G	49	2	7	..	..	58	16
Shimpoli	9 — E	20	..	1	..	..	21	4·76
Sutarwada, Hamlet of Shahad.	18 — D	17	1	..	..	..	18	5·5
Tale, Hamlet of Eksar ..	8 — E	58	..	..	..	..	58	*Nil.*
Tari, Hamlet of Kolset ..	7 — C	Spleens not classified.			..	..	27	41
Tarodi, Hamlet of Dongri.	2 — C	49	1	1	..	..	31	6·5
Thakur, Hamlet of Eksar.	8 — E	21	2	1	..	..	24	12·5
Trombay	22 — L	74	1	..	..	..	75	1·3
Utan	5 — B	194	1	1	..	..	196	1·
Vakola, Hamlet of Kolhe Kalyan	19 — F	53	..	..	..	..	53	*Nil.*
Valnai	11 — E	37	4	..	..	..	41	9·8
Vesava	14 — C	108	2	..	..	..	110	1·8
Vikhroli	17 — K	2	3	12	8	13	38	95
Vila Parla	18 — E	127	1	..	..	..	128	0·78
Vadavli (in Trombay) ..	21 — I	13	7	5	2	1	28	54
Vadavli (N. of Thana) ..	5 — M	Spleens not classified.			..	..	133	59
Wagbil, Hamlet of Kavesar.	6 — N	Spleens not classified.			..	..	164	42
Yerangal	13 — B	60	..	..	..	..	60	*Nil.*
Yeur	8 — D	Spleens not classified.			..	..	88	94
Total of children examined	..	..	..	..	..	..	7,156	..

The spleen census has its Scylla and Charybdis. On the one hand, if one strikes a percentage on a very small number of children, as one sometimes must, if hamlets are to be taken separately from the villages to which they belong, there is a certainty of a very obvious kind of error. On the other hand, if the figures for a village and a small hamlet belonging to it are added together for the purpose of striking the percentage on as large a figure as possible, though the children of the hamlet have a larger proportion of enlarged spleens than those of the village, the percentage struck is not accurate either, being rather higher than that of the village, and a good deal lower than that of the hamlet.

The principle here followed has been to compound the figures for a village and its hamlets only when there was no great difference found between the proportions of enlarged spleens, and to employ a special sign on the map to indicate a place where the rate has been calculated on a very small number of children.

In this connection the matter of class composition in different villages and hamlets must be alluded to. It is found, as a rule, that the poorer fed a class or caste of people is, the more liable are its members to malaria, and *vice versâ*, and the peoples of Salsette are no exception to the rule. The children of the well-to-do commercial castes who reside in villas in Salsette for part of the year may be left out of account: their spleen rate would not have been taken even had they been in residence, as their children are not born and bred in Salsette. Bráhmins, again, form such a relatively small proportion of the inhabitants of villages that no conclusions can be based on any figures relating to their children. But in some villages almost the whole, and in others quite the whole of the inhabitants are Indian Roman Catholics, and it was quite noticeable that their higher standard of living makes them tend to have a lower spleen rate than the average of cultivators. At the other end of the scale the distinctly primitive castes, such as the Dublas and Varlis, tend to have the highest spleen rate of all.

Had it been possible to have dealt with this factor of the standard of living alone, and to demonstrate its influence by comparing the spleen rate, say of considerable numbers of Christians with that of considerable numbers of Dublas living under identical conditions, instructive figures could have been obtained. But in Salsette it is another factor that mainly determines the amount of malaria in a given number of people of any class, namely, the physiographical situation of their villages. Indian Christians in Salsette tend to live in villages in non-malarious areas by the sea: Dublas and Varlis tend to live in hamlets in malarious areas on the lower slopes of the hills. That when, as an exception, Indian Christian cultivators live in a particularly malarious area, they suffer as badly as anyone could, is shown by the case of the entirely Christian village of Vikhroli, where the spleen rate was 95 per cent. and where the proportion of very large spleens was particularly high.

On account of this impossibility of comparing different peoples living under sufficiently identical conditions no attempt at classification by race, religion or caste has been made, and this fact must simply be allowed for in considering the value of the spleen rate as it was taken.

As in other places in India, the tendency of urban areas to be remarkably free from malaria is strongly manifested in Salsette. This tendency is apt to be slightly exaggerated in a spleen census of mixed urban and rural areas, from the fact that, without very special measures, such as house-to-house visitation, one is almost wholly dependent for the spleen census in towns on the examination of school-children, as the street children, among whom the percentage of enlarged spleens might be expected to be higher, cannot be collected in the ready way in which they usually are in villages. But, allowing for this, the tendency is remarkably evident. Exceptionally great facilities for the propagation of the local carrier of malaria, such as there are in the malarious wards of Bombay City, appear to be necessary, otherwise a densely populated urban area is the last place where malaria is to be found.

The table shows that out of 1,001 children of the Bándra-Dánda Peninsula, of whom by far the most were born and bred in Bándra bazaar, only one was found on examination to have enlargement of the spleen. Making all allowance for the accessibility of Bándra to the sea-breezes the figures are very remarkable.

Still more significant, however, is the case of the Thána bazaar. The spleen rate here, which was taken by the Civil Surgeon, Major Kukday, I.M.S., was only 3·7 per cent. in the midst of a tract of country the intense malariousness of which may be seen by a single glance at the spleen map. Only the thick of the bazaar of Thána is non-malarious: the suburbs, such as Navpáda, are severely malarious.

The one phenomenon that is brought out most prominently by the map and its figures is the evident relation of malaria to the range of hills shown on it. In other parts of India also the tendency has been observed for malariousness to increase as the hills are approached. Thus, in one investigation the percentage of children found to be infected with malaria in the environs of Calcutta was *nil;* further and further north it was 12, 25, 40, 55, and at the foot of the Himalayas 72. And not only in Salsette but anywhere in the Thána District one finds it to be a fact well

known to the villagers, and capable of ready demonstration by the taking of a spleen census, that it is the dwellers on the slopes of the hills, or near their bases, that suffer most severely from malaria.

In this connection the mainland part of the map, on the east side, may profitably first be studied. The remarkable feature of this part of the country, where the Parsik range of hills towers above the creek, is the line of villages along its sides that have been completely, or almost completely deserted on account of malaria. (Villages thus deserted are underlined in red on the map). In places down by the creek-side, such as Itáva and Iravli, the descendants of the former inhabitants of those villages are still living. All the account they can give of the matter is that about forty years ago the villages on the slopes had to be abandoned on account of the " wāīt hawa" (literally the ' mal-aria '), of the mountain. Even down at the water-side the influence of the proximity of the hill is seen in the spleen rates found in the villages. On the east of the range, where the villages are entirely shut off from sea-breezes, the spleen rates are among the highest possible: 82 per cent. at Kausa, and 93 per cent. at Mumbra.

An attempt that was made ten years ago to solve the problem of house accommodation at Thána by building bungalows for Government officers on one of the northern slopes of the Parsik range, was a complete failure. The bungalows proved as malarious as the villages of the Parsik range had been, and residence in them has had to be given up entirely.

The case of the island of Trombay, forming the south-east corner of Salsette, may next be studied. With its hill of trap-rock, rising to 1,001 feet, whose sides, as they slope down to the sea, are covered with the soil which is a product of the disintegration of the trap, and the edging of salty alluvium along its shores, on which the abundant growth of trees and grass comes to the usual abrupt conclusion, the island of Trombay forms an excellent miniature edition of Salsette. No detailed demonstration of the relation of malaria to the hill is required; the figures show the closeness of that relationship so well themselves. Villages close to the base of the hill or on the slopes of one of its spurs, have a spleen rate of over 50 per cent., which rapidly gives way to smaller rates, ranging from 10 per cent. upwards, at a little distance from the hill. The hamlet of Charai, at the cross-roads, is far enough away to have only 7 per cent. Further north, Chembur, which is still nearer the edge of the tree and grass-covered area, has but 4·2 per cent. But what will be found most significant is that the spleen rate of the children of the Mahárs and Bhangis of the Bombay Municipal Refuse Depôt, a little further north still, is *nil.*

People will not, of themselves, build their villages right out in the open, away from the shade of trees, nor will any one build villas or bungalows either. This is only natural, and it must be accepted as an axiom in considering what advice is worth while giving. But the one drawback of it, in the case of a malarious tract of country, is well seen here, where the Mahárs and Bhangis of the Refuse Depôt are not only better off in respect of malaria than the well-to-do artizans of Chembur, but have absolutely no spleen rate at all. The reason for it consists in the fact that they cannot choose their place to live in themselves. Their occupation necessitates their living out on the salty alluvium, where there are no trees, and the shortest of grass will hardly grow. Nobody else would live in such a place, and the result is that no other village in the whole of the east of Salsette is like theirs: it is the only one that does not have malaria in it.

The effect of the sea-breezes is well seen in the case of the village of Trombay itself, which has a spleen rate of only 1·3 per cent., in marked contrast to the neighbouring villages inland.

If a general view is taken of the island of Salsette it will be seen that the central hills are surrounded with a ring of villages all having a spleen rate of anything between 50 per cent. and 95 per cent. Yeur is the village at the highest altitude that was visited: its rate is 94 per cent. It is very noticeable how, as one passes outwards from the hills to the sea, the spleen rate decreases, even where it is only as creek that represents the sea, as in the case of the eastern side of Salsette, while on the western side the villages most completely exposed to the sea-breezes have no spleen rate at all. The gradation is in some parts very noticeable; indeed one might in some parts draw lines connecting figures of the same colour and find that they ran parallel with the direction of the range and of the coast-line. Corresponding with the isobars or isotherms on a meteorological chart, these lines of approximately equal spleen intensity might be called " isosplens." Starting near Thána for example, one such isosplen (red) would run from Navpáda southwards through Mulund, Nána, Bhatti, Kanjur, Hariáli and Vikhroli. Another (brown), further from the hills and nearer the creek, would run from Gavhán through Navghar and Bhándup. Another (orange) would curve round the head of the Thána creek where it contracts, opposite Thána town, to the narrow channel connecting it with the Bassein creek, and would include Itáva, Kalva and Kopri. In this grassy tract of country through which the G. I. P. Railway runs, from Ghátkopar northwards, the hills are too near the creek to leave room for villages so free from malaria that

a green isosplen could be drawn at all. To be able to draw an isosplen in each of the four colours one would have to start at the north-west side of the hills. Here the red would begin at Masha and pass southwards through the hamlets of Dahisar, and through Kakda. South of this the villages close to the hills are actually deserted so that no spleen rate can be taken in them at all. The brown isosplen would begin, a little further out from the hills than the other, at Kashi, and pass through Mira, then re-appear first at Devi, a hamlet of Magatna, and then again to pass through Bharodi and Pahádi. The orange would begin at Ghodbandar, a little further north than the others. Here the hills come right down to the creek, and there is, so to speak, a direct conflict of opposing influences. The sea-breezes do exert a marked effect, for Chodbandar has a much lower spleen rate than any other village in Salsette commanded to such a degree by the hills. This orange isosplen would pass through Dahisar, Kanheri, Babái, Poisar and Gári. Outside it, and just before the tree and grass-covered country gives place to the alluvial flats one might draw a green isosplen of villages that have a spleen rate of from five to ten per cent. It would start at Naytodi, and run south through Borivli, Shimpivli, Kandivli, Valnai and Malad. West of this and fringing the sea-coast, is the long series of villages built on what are more or less islands separated by creeks and mud-flats from the mainland of Salsette, which were mentioned in Chapter I. In most of those villages there is absolutely no spleen rate at all. In just one or two is there a rate worth noticing. Thus Dongri village has two hamlets, Tarodi and Pali, that lie just at the base of a small hill, one on each side of it. In their case there is thus a reproduction in miniature of the conditions that bring about malariousness elsewhere, and the one hamlet has a spleen rate of 6·5 per cent., and the other of 5·6 per cent. But, taking those places on the coast as a whole, from Bháyandar on the north down to Bándra on the south, they are found to be all either wholly free from malaria, or affected by it to a perfectly negligible extent.

Turning to the north-east corner of Salsette, we find very malarious conditions to the north of Thána. Though not quite so badly affected as those nearer the hills, the villages on the Bassein creek have a considerable spleen rate; they are too far round the corner, so to speak, to get the benefit of the sea-breezes. There are two villages deserted on account of malaria here, Mánpára and Kavesar; the inhabitants of the latter have all shifted down to Wagbil on the creek-side. The case of Kolshet, and its hamlet, Tari, the inhabitants of which work the ferry for the Agra road traffic is instructive. Kolshet is not out of the jungle; it is surrounded with trees and grass and has a spleen rate of 84 per cent. Tari is on the shore, beyond the edge of the trees, just a hundred yards or two down the road, and its spleen rate is less than half that of Kolshet.

There now only remains for consideration a limited but important area in the south of the island, bounded on the north by the hills, and on the south by the Bándra creek. For the most part of this area is not under the influence of the hills, but at the north-west and north-east corners of it are two places, Andheri and Ghátkopar, which may be said to be just on the edge of the danger zone. The spleen rate of Andheri, 2·7 per cent., would not be noticeable were it not that nowhere south of it is there practically any spleen rate to record at all. At Ambivli, just north of Andheri, it is 4·5 per cent. A little further still up along the Ghodbandar road we have on the right the deserted village of Mogra, and on the left, on the slope of a grassy hill, a hamlet with a spleen rate of 25 per cent.

At Ghátkopar the hill castes, who nowadays mostly work as rice-field labourers, and whose work takes them to fields close to the hills, where they camp out during the rice-harvest, have a spleen rate of 73 per cent. The commercial classes, mostly Kacchi Bhattias who go to Bombay daily to their business, but who are resident here all the year round, have a spleen rate of only 5·2 per cent. Their children are not exposed in the way the others are in the malaria season, and they have every advantage that good housing and good feeding can give; more typical little banias and banianis could hardly be seen. The sudden change which a short distance from the hills makes may be seen by comparing the spleen rate of Kirol, where the people mostly work in the rice and grass-lands at the foot of the hills, with that of Old Kurla, down by the head of the Bándra Creek.

It will be seen how free from malaria are places right away from the hills, such as New Kurla, Kolhekalyan, Vakola (close to Santa Cruz Cantonment), Santa Cruz and Vila Parla.

In attempting to account for that relationship of malaria to physiography which is so unmistakably brought out by the spleen census, it is impossible at present to do anything more than surmise that it is the dampness of the ground associated with the constant movement of underground water from the hills towards the sea, and the shelter from the wind provided by the rank growth of trees and grass on the soil formed by the disintegration of the trap, that enable the anophelines to survive so well after the breeding-season, and to persist in numbers long enough into the dry

season to become infected, to develop the parasite, and thus to start the cycle of infection of the mosquito by man and of man by the mosquito.

Recommendations.

The subject of practical measures for the diminution of malaria in Salsette may be considered under two headings, prevention in existing villages, and prevention in new building areas.

Prevention in existing villages.—It is here the indigenous population that has to be thought of, both in its own interests and in those of the citizens of Bombay. While, in the abstract, the indigenous population of any malarious táluka of the Thána District is as deserving of protection as that of any other, there is a strong practical reason for devoting special attention to the case of the villagers of Salsette, in the proximity of this highly infected area to the City of Bombay, even if the tendency to suburban building is left out of account.

Without prejudice to anything recommended under the second heading it may at once be said here that in rural Salsette anything like a general attack on the breeding-places of the mosquito is out of the question. We are not here, as in Bombay, dealing with a series of artificial breeding-places, localized over a limited area of very valuable ground, but with natural breeding-places widely distributed over a large tract of country, most of which is of no greater value than such rice or forest land would be in any other part of the Presidency.

The only series of breeding-places that can be abolished, and should be abolished, is the chain of borrow-pits along the B.-B. and C. I. Railway, which, as already pointed out, continue to pour forth mosquitoes in October, weeks after all the natural breeding-places in the neighbourhood have dried up. The line runs through a distinctly malarious tract of country from where it leaves Andheri Station to where it emerges on to the alluvial salt-lands at a point between Borivli and Bháyandar Stations, a little to the north of Dahisar village. The worst part of this region is that north and south of Goregaon Station.

The simplest way of dealing with borrow-pits is to run them into one another by a connecting channel, and to have outlets here and there into nullahs, as they occur. But as the Railway Company has already taken up the necessary land for the quadrupling of the line the opportunity should be taken when construction work is in progress, to abolish the old borrow-pits altogether, and to see that no new ones are left either. Exactly how they shall provide materials for the extension of embankments is a matter for the railway engineers to settle. The only principle that has to be laid down is one which is coming to be well understood in connection with engineering in the tropics, that excavations should be made in such a way that they will drain promptly and completely into the nearest water-course.

It would be well if the due observance of this principle were in future made a regular condition of the acquisition of land by railway companies.

Though, with this exception, *breeding-places* cannot be attacked there is some evidence that it would be worth while to attack the *resting-places* of mosquitoes. The extraordinary immunity from malaria enjoyed by those whose villages are outside the tree and grass-covered area, and are completely accessible to the sea-breezes is an obvious indication to expose to the sea-breezes as far as possible villages less happily situated. Every encouragement should be given to those who own or occupy the grass-lands of villages to cut the grass early, and keep it cut, in the actual vicinity of both villages and hamlets, and also to cut it early and keep it cut, on the side of any hill which may command a village or hamlet. While people cannot be expected to do without trees to shade their actual houses, the presence of a space free of trees as wide as possible around the village site will tend to promote the necessary ventilation, and the presence of brushwood or undergrowth of any sort in the vicinity of villages should in any possible way be discouraged.

While a great proportion of the adults in malarious places have acquired immunity by slow degrees, or are alive merely as examples of the survival of the least susceptible, the disease is always in an active condition in the case of the children whose spleens are the reservoirs which keep up the supply of the infection, and carry it on from one fever season to the next. The diminution of the size of those semi-liquid reservoirs should therefore be the chief aim of our anti-malarial measures, for if one cannot protect the children from the mosquitoes the obvious thing to do is to protect the mosquitoes from the children. Repeated individual attention to each child with an enlarged spleen is what is necessary; such children are only indirectly infectious, but for practical purposes they should be regarded as if they were directly infectious, and should be looked upon as an immediate source of danger to their neighbours, rich or poor.

The only way to keep up this constant attention to the state of the children's spleens is by means of a travelling dispensary. It is not suggested that Salsette should merely be one of the 26 tálukas of the Presidency to which one of the existing travelling dispensaries is sent during the fever season, but that Salsette should

have an itinerant dispensary of its own, worked on special lines, and financed independently of Provincial or of Local funds. The endowment of such an institution by a private individual, or by the trustees of a charitable fund, would be of benefit not merely to the inhabitants of one town, as in the case of a stationary dispensary, but to the whole of the people of the island who are out of reach of the existing hospitals and dispensaries; moreover, as a preventive institution, its object would be to protect those who are well besides treating those who are actually sick, and so to help the island to become a healthier place for Bombay people to come and live in. To be of any real service the work would have to be carried on the whole year round as each individual spleen would need repeated and systematic attention and it would accordingly be advisable to provide a caravan for the purpose, in which the Assistant or Sub-Assistant Surgeon in charge could comfortably live even in the monsoon months. One compartment of this would be fitted up as a surgery, and a considerable stock of medicines could be kept in it. The caravan would be drawn by a yoke of bullocks. Two peons would be required. One would accompany the doctor on his visits to villages off the road, and carry the haversack he would take with him; the other would stay behind to look after the caravan. If the doctor wished to take any members of his family with him in the dry weather a small tent could be added to the equipment.

Salsette is fortunate in having its interior encircled by a made road, so that the dispensary could actually circumambulate the island. Experience would show what time was required in order to work the villages once properly, and the period of a perigrination would be fixed. Each time the caravan came round its books would be inspected and its stock made up, by the Civil Surgeon, Thána, or by the Medical Officer of Bándra Hospital, who would have to satisfy himself that the work done was not being confined to a mere distribution of medicines, but that the individual children, whose names were entered in the registers as having been found to have enlarged spleen, were being attended to on each round, and sufficient medicines left for their treatment.

The name of the dispensary, including that of the person whose memory it was desired to perpetuate by the gift of it, could be inscribed on the sides of the caravan.

Prevention in new building areas.—If the investigation on which this report is based shows that certain of Mr. Mead's original suggestions are not such as can be carried out, it should be remembered that Mr. Mead in his report was the first to suggest a malariological investigation in Salsette in connection with the town-planning he advocated.

Before individual areas are considered it may be well to lay down certain principles which should be adopted where building is being sanctioned. In the first place, the leaving of any excavation which can hold water, in connection with the building of houses, should be prohibited by bye-law. Wells, again, are very prolific breeding-places of mosquitoes and they are not needed in places that have a pipe water-supply. Their construction should not be sanctioned in such places. Legal powers to order the closing of wells after the introduction of a water-supply would be advantageous; they need not be made use of in places where there is little malaria, and where it is not showing signs of increasing. Tanks also are undesirable. To do without them means extra provision, in connection with the pipe water-supply, of well drained dhobi ghâts, and of places where buffaloes can be washed by their owners, as it does not do to prohibit tanks, and not provide for the due performance of their functions otherwise.

A good deal more can be done to prevent malaria where the development of a regular garden city is in question than where it is merely a case of giving permission to individual owners of plots to build. It is much easier in the former case, for example, to act upon a recognition of the fact that a combination of trees or bushes with grass tends to make a place far more malarious than it would be with only the trees, or only the grass. But the practicability of preventing this combination should always be kept in mind where new acts, or new bye-laws, are being drafted.

Even looking at the matter from the point of view of the safety of the well-to-do, it pays in the planning of a new urban area to see that a certain standard is kept up for the building of the houses for the poorer classes in the local bazaar, and that the promiscuous running up of huts for casual labourers and their families is discouraged.*

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* Thána is one of the two districts of the Presidency that suffers the most from plague. While touching on the subject of a possible future garden city in Salsette it may not be out of place to note how well it would pay its promoters to make it plague-proof. This does not mean extra expense. It only involves laying out and building the place so that rats will not find it worth while to live in it. Grain would have to be stored, and banias' shops be kept in special buildings not inhabited by human beings, and cattle and human beings would have to live apart. The poorer houses would be built like the inexpensive, but rat-proof houses of Eastern Bengal, where plague, though often introduced, has failed again and again to take root. For details of the subject the *Journal of Hygiene*, Plague Supplement I, pages 189 to 192, may be referred to.

The question as to what parts of the island are really suited for residential development may now be considered. It is just because there are such wide variations in the amount of malaria in the case of places situated at no great distance from one another and otherwise equally well suited for development, that it is so well worth while to pay attention to the matter. It is not as though Salsette were, like so many localities in India, simply a malarious tract of country in which one had to make the best of it, and be thankful to find some spots here and there that were rather less malarious and one or two that were distinctly less malarious than the rest. The point about Salsette is that while parts of it are about as malarious as any place could be, there are such considerable areas with practically no malaria at all that one can quite well afford to set up a very high standard indeed. The Central Malaria Committee, looking to the general experience of India, classifies areas as "healthy" in which the average spleen rate is not over ten per cent. In spite of the intense malariousness of parts of the island, Salsette can quite well afford not to call ten per cent. healthy, when it is a question of finding room to house a considerable part of the future suburban population of the city of Bombay. There is space enough without. It is only want of means of communication with Bombay that has in the past so often compelled those who wished to build to content themselves with a plot of ground in a malarious or in only a relatively non-malarious locality. Roughly speaking, it may be said that no Indian who has to go in to Bombay daily will live more than a mile from a railway. Hence it is that healthy tracts have been left undeveloped, while villas, that their owners only occupy for certain months of the year, are clustered in numbers round the stations of the B.-B. and C. I. Railway in parts of the island which have, within the last generation or two, become so malarious that the indigenous population has largely disappeared.

The whole question of the development of healthy areas in Salsette is bound up with the question of the possibility of providing efficient means of communication with them. To make it possible for means of communication, such as main roads along which an electric or petrol tramway can be run, to be profitably provided, it will be necessary in the future to concentrate attention and funds upon places that really have a future before them. The area receiving attention has hitherto been too extended a one. Town-planning has too often consisted in going after people who have built villas in unsuitable areas, and treating these as if they were the nuclei of future townships. The discouragement of building in unsuitable places is a necessary corollary to the encouragement of it in healthy ones.

Coming to parts of the island in detail, one may say without hesitation that Trombay may be put aside as distinctly unsuitable for development; there is not room for a healthy area between the hill and the mud-flats. Chembur might be considered a possible place, but the area round it is not sufficiently large to make it alone worth special means of communication.

The part of the island between the hills and the Thána Creek, through which the G. I. P. Railway runs northwards from Ghátkopar Station, is one which also is wholly unsuitable for development. The abundant grass-lands and the plentiful space around Vikhroli Station led to the selection of Vikhroli by a committee which sat in 1909 as the best site on which to locate the Bombay Municipal Slaughter-house, when that is removed from Bándra, with its allied trades. But the spleen rate shows that the scheme would be quite impracticable; there would be such incessant invaliding among the employees, and such a high death-rate among their children. The area is as unsuitable for institutions as it would be for villa residences.

No part of the island—north of Thána—would be suitable for development either, even were it provided with means of access.

Both New and Old Kurla are non-malarious, though there is no room near the Railway Station for building, unless reclamation of flats were undertaken. Ghátkopar is so much on the border-line and so near the danger zone that it is more difficult to give an opinion about it. The part south of the railway is safe enough, and there appear to be some healthy bungalows north of it, but one would certainly deprecate any encouragement of building on the Agra Road.

On the west side of the island the large area round Bháyndar Station in the extreme north, consisting of salt-lands, is unobjectionable from the present standpoint, as it is so free from malaria. Some Indian commercial men do not find Bháyndar too far from Bombay to live in, but the want of a water-supply is the great hinderance to its development, and there is, unfortunately, no other area suitable for development with which it could combine in managing to afford one.

The next area to be considered is that to the south of this, from Dahisar, between Bháyndar and Borivli Stations, along the B.-B. and C. I. Railway, to Andheri, which may be considered its southern limit. The Ghodbandar Road runs through it close to the railway, and it is along this road that there has been so much building of bungalows mostly used only in the hot weather, the only reason for building them in this malarious part of the island having been the presence of the railway, on which station after station has been opened for suburban traffic as

the bungalows grew in number. Not all parts of this area are equally malarious, that round Goregaon Station is the most so. But the railway runs much too near the central hills of Salsette to allow the neighbourhood of its stations within this area, which is bounded on the East by a line of villages deserted years ago on account of the increasing malariousness of the climate, to be fit for anything that could seriously be called town-planning. It does not do anybody any particular harm that well-to-do people, who can bring their servants and their supplies from Bombay, should elect to live here in the hot weather if it suits them. Their doing so does not involve the planting down of any all-the-year-round population of poorer class people; that is why it is unobjectionable. But to provide them with roads, water-supply, markets and schools would not only use up part of funds that should be concentrated on the development of more hopeful parts of the island and attract future settlers to the less desirable places; it would also mean that bazaars would form, in which middle-class and poor people would be living all the year round, in a climate which would involve a sick-rate among them and their children higher than there is any need for in the case of people who are to live in Salsette.

There should be no extension northwards of the road already built to the place of pilgrimage at Mandapeshwar. The really important roads in this area are those leading from the railway stations to villages on the west coast; those should continue to be kept up to their full width. There is no objection to the construction of small lengths of accommodation road, at the discretion of the Officer in charge, Salsette Building Sites, for the benefit of existing groups of villas badly needing an exit to the railway. But the principle should be observed that their construction is not to encourage the formation of further bungalows and a bazaar. Requests have been made for an English school at Malád or Borivli, where a certain number of upper-class people do live all the year round. This is contra-indicated on the same principle of non-encouragement. It has also been proposed to utilize part of a charitable fund that exists for the provision of dispensaries in Salsette, to establish one at Borivli. Strictly speaking, the same objection should hold good in this case also, but it would be rather paradoxical to object to the establishment of a dispensary in a place because the neighbourhood was an unhealthy one. Borivli is a little market-town for a great part of north-west Salsette, and a dispensary there would serve a number of existing villages.

There now remain the two healthy areas of Salsette to be considered; that lying to the south of, and beyond the influence of the hills, and that consisting of the islets of the west coast.

As regards the more immediate future the area in the south of Salsette is the more important from the point of view of actual development. It includes the Bándra-Dánda Peninsula, and its boundaries can easily be defined; they form a triangle. Andheri is for the B.-B. and C. I. Railway what Ghátkopar is for the G. I. P., the station on the border line, north of which the country very rapidly becomes malarious. No development should ever take place north of the metalled road that runs east from Andheri, and to go too far east along this road would bring one to near the southern end of the hill range. A line is best drawn from Andheri to Old Kurla, to leave out any country within the range of its influence. The base line of the triangle is the Bándra Creek, and the third line is drawn to meet it from Andheri in the direction of Dánda, or of Bándra point.

The flats of the Bándra Creek extend for some little distance into this area, and it is further limited by the existence of the danger zone of the rifle range, south of Santa Cruz Station, and the cantonment of Santa Cruz, near the village of Vakola, but these still leave a considerable area of ground, only parts of which have been built over. The only reason why the rest has not been considered in town-planning schemes, is that it lies more than a mile from the nearest railway station. There is none of it beyond the reach of the water-supply scheme which is being prepared by the Engineer in charge, Salsette Building Sites, so that the only problem is that of means of communication.

The problem would, of course, be most completely solved if it paid the two railways, and if it suited their policy, to have a connecting line between, say Kurla and Andheri, when electrification is brought in. Failing this, such an undertaking as a petrol tramway, to be constructed along one of the future roads within the area, would best meet the difficulty. As regards roads, it has to be remembered that, building apart, the present utter want of means of communication between the two sides of Salsette Island is one that will have to be fulfilled in any case. Strangers to Bándra can hardly believe that there is no way to a town so close as Kurla, and that the Agra Road can only be reached by long and circuitous routes. One of the roads that have been provisionally suggested would continue the Bombay Improvement Trust's new road on the west side of the G. I. P. Railway line from Kurla. Besides running northwards to join the Agra Road it would have a branch crossing the head of the creek and connecting up with the present road that runs westwards from Santa Cruz Cantonment to the station and the Ghodbandar Road. Another

suggested road would run westwards from the acute bend of the Agra Road north of old Kurla. Perhaps the most important of all the projected roads is that which would run west of the narrow Ghodbandar Road northwards from the Bándra Municipal Building towards Andheri.

But although it is in connection with this southern area that the attention of the town-planner will be most profitably directed in the meanwhile, no one who has visited the islets of the west coast, of which Mr. Mead writes with such enthusiasm, can fail to see in some of them the most ideal of all sites for a garden city. With those which could most easily be made accessible from the B.-B. and C. I. Railway the great difficulty is that of inducing owners or occupiers of the land to allow development to take place. The Khot of Juhu is represented by some twenty odd individuals, so it is small wonder that this beautiful little island, so close to the railway, and so healthfully situated, remains totally undeveloped. Vesava, on the other hand, has already been largely taken up. For a garden city, to be developed as a whole, say by a company, and in connection with which boating and golf throughout the year could be provided for its sporting residents, the village lands of Malavni would be decidedly the most suitable, could the difficulty be got over of inducing occupiers of agricultural land to allow development; that is to say, development as opposed to the mere dotting about of the peninsula with bungalows on available bits of land. A copy of the village map, showing the tenure of the lands, accompanies this report. There is water-supply enough to allow building to start, but not to go on far, and it would depend on what was thought now of the future prospects of Malavni whether it was considered advisable to attempt to make provision for its future needs in projecting the water-supply for the south of Salsette. Instructions might meanwhile be given that Government land at Malavni should not be sold for agricultural purposes.

Communication with the railway would have to be provided by petrol or electric tramway along about 4½ miles of road already constructed up to part of its width, between Marva village and Malád Station.

Building-stone and lime are available in abundance locally, and as a brick and concrete factory is about to be built on the coast in the neighbourhood, the question of building materials would present no difficulty.

A very little reclamation would link up with Malavni the neighbouring villages of Charkop, Marva and Aksa.

It is not necessary in this report to go into the subject of the suitability of the other village lands of the west coast, which, unlike Malavni, would mostly have to be reached by the bridging of creeks. It would only be after the development of Malavni that their future would have to be thought of.

It is only necessary in concluding this report to point out that it is not alone in Salsette that it is worth while to bear in mind in connection with building sites that relation of physiography to malaria which is so striking a feature of the climate of the Konkan, but which there has not previously been an opportunity of demonstrating in any detail. His experience of this relation has been of considerable use to the writer already in giving an opinion regarding the different places suggested as the new head-quarters of a district, and there may often be smaller locations to be selected, such as that for a police post, for example, where a difference of position, quite within the limits of administrative feasibility, might make a very considerable difference to the health and efficiency of those whose duties called them to occupy it.

APPENDIX I.

Table of anophelines, showing places where found, and name of nearest railway station. Stations on the B.-B. & C. I. Railway are taken in order going "Up" towards, and stations on the G. I. P. Railway " Down " from Bombay. The record of N. rossii has been omitted from this table. The term " Gauthan " means the actual village site.
M. Barbirostris was found at the following places :—

(BORIVLI RAILWAY STATION).—Larvæ in Railway borrow-pit, mile No. 21 east side ; 20 east side ; 21-24, 20 west side ; No. 24 west side.

DAHISAR.—Larvæ in 2 wells in S. No. 133.

KASHI.—Larvæ in rice field in S. No. 6 ; well in S. No. 95 ; rice field in S. No. 3 in the village. Adults in cowshed in Gauthan.

MIRA.—Larvæ in rice fields and stream named Dhobidai ; tank named Chari. Adults in cowshed in Gauthan.

(KANDIVLI RAILWAY STATION).—POISAR—Larvæ in well of D. L. B. Adults in cowshed in Gauthan.

(MALAD RAILWAY STATION).—ARE—Adults in cowshed in Gauthan.

CHARKOP.—Larvæ in well in S. No. 12.

KURAR.—Larvæ in well in S. No. 11.

MALAD.—Adults in cowshed in Gauthan.

MALAVNI.—Larvæ in wells in S. No. 12.

VALNAI.—Larvæ in tank in S. No. 10 ; and tank named Khandala.

(ANDHERI RAILWAY STATION).—Adults in cowsheds in S. Nos. 19 and 9.

AMBIVLI.—Adults in cowshed.

BANDIVLI.—Larvæ in tank in S. Nos. 24 and 25 ; wells in S. Nos. 1, 17 and 19.

CHAKALE.—Larvæ in rice field in S. No. 39.

MAROL.—Adults in cowshed in Gauthan.

MANJAS.—Adults in cowshed in Gauthan.

WYARAVLI.—Adults in hut in Gauthan.

(BANDRA RAILWAY STATION).—Larvæ in Railway borrow-pit near mile No. 1 east side ; well right hand side of St. Joseph's Convent School ; pool in S. No. 241; wells in S. Nos. 235, 241, 223, 204, 189, 203, 240, 198, 197, 239, well in Gauthan ; well in Bungalow No. 40 ; well in Rungari's chawl, well in Municipal School No. 1.

MATMAULI (MOUNT MARY).—Larvæ in wells in S. Nos. 280, 271, 27, 282, 281, 268, 246, well of Bungalow No. 81, well of houses Nos. 4 and 38, well in S. Nos. 270, 282, 281, 270.

PALI HILL.—Larvæ in well in S. No. 325.

(GHATKOPAR RAILWAY STATION).—Adults in cowshed in Gauthan.

KIROL.—Adults in pucca house in Gauthan.

MAHAL.—Larvæ in wells in S. Nos. 139, 147.

MAHN KHURD.—Larvæ in wells in S. Nos. 88, 91, 38.

MARAVLI.—Larvæ in wells in village.

NAVALI.—Larvæ in rice fields in village.

WADHAVLI.—Larvæ in wells in S. No. 2 ; pool in S. No. 1 ; well in village.

(VIKHROLI RAILWAY STATION).—HARIYALI—Adults in cowshed.

PACHKOLI.—Larvæ in pool in the village.

(BHANDUP RAILWAY STATION).—Adults in cowshed in Gauthan.

(THANA RAILWAY STATION).—DHOKALI.—Larvæ in wells in the village. Adults in cowshed in Gauthan.

KAVESAR.—Adults in cowshed in Gauthan.

KOLSET.—Larvæ in well in S. No. 268. Tank in village ; wells in S. Nos. 247, 10.

KOPRI.—Adults in cowshed in Gauthan.

MANJIVDA.—Adults in cowshed in Gauthan.

MANPADA.—Larvæ in well in the village.

THANA.—Larvæ in well in B. No. 127 ; rice field in S. No. 6 ; well in H. No. 56 ; well in B. No. 122 ; well in H. No. 194.

Ny. Fuliginosus was found at the following places :—

(BHAYNDER RAILWAY STATION).—Larvæ in Railway B. P. near mile No. 22 east side of Railway line of B.-B. and C. I. Railway B. P. mile No. 24 west side ; mile No. 25 east side.

(BORIVLI RAILWAY STATION).—Larvæ in Railway B. P. near mile No. 23 east side ; mile No. 22 west side ; mile No. 20 west side ; of Railway line of B.-B. & C. I. Tank in the same village.

DAHISAR.—Adults in cowshed in Gauthan.

EKSAR.—Larvæ, rice field in S. No. 20 ; tank in S. No. 202.

KASHI.—Adults in cowshed in Gauthan.

MAGATNA.—Adults in cowshed in Gauthan.

MIRA.—Larvæ, pool in the same village ; in S. No. 323 ; tank in the same village. Tank, Chari, in the same village ; rice field ; stream, Dhobidai running by the village. Adults in cowshed in Gauthan.

(KANDIVLI RAILWAY STATION).—AKARLI.—Larvæ in pool, well in the village. Adults in cowshed and hut in Gauthan.

KANDIVLI.—Larvæ in Railway B. P. near mile N. 19 east side, west side of the Railway line of B.-B. & C. I. ; tank near S. No. 15 ; rice field in S. No. 12. Adults in cowshed in Gauthan.

POISAR.—Larvæ in pool stream in S. No. 5 of the village. Adults in pucca houses and cowshed in Gauthan.

(MALAD RAILWAY STATION).—ARE—Adults in hut in Gauthan.

KURAR.—Larvæ in tank in the village in S. No. 3.

MALAD.—Larvæ in Railway B. P. near mile No. 18 east side of B.-B. & C. I. Railway ; well ; rice field in S. No. 106 of the village. Adults in cowshed in Gauthan.

MALAWANI.—Larvæ, well in S. No. 64 ; tank ; wells in S. Nos. 50 and 88 ; tank to the east of S. No. 99.

WALNAI.—Larvæ in rice field in S. No. 14. Adults in cowshed in Gauthan.

(GOREGAON RAILWAY STATION).—PAHADI.—Adults in cowshed in Gauthan.

GOREGAON.—Larvæ in Railway B. P. near mile No. 17 west side ; 16 east side of B.-B. & C. I. Railway ; tank in S. No. 100 ; well in S. No. 24 in the village.

(ANDHERI RAILWAY STATION).—Larvæ in Railway B. P. near mile No. 17 east side, 16 west side of B.-B. & C. I. Railway ; Railway B. P. in S. No. 24 ; rice field ; tank in S. No. 81; rice field in S. No. 81 in the village.

BANDIVLI.—Larvæ in pools in S. Nos. 41 and 24 ; well in S. No. 17, and tank in S. Nos. 24 and 25 in the village

BRAHMANWADA.—Larvæ in well in S. No. 54 ; tank in the village. Adults in cowsheds in Gauthan.

CHAKALE.—Larvæ in tank in S. No. 48 in the village ; and rice field in S. No. 39. Adults in cowsheds in Gauthan.

GONDIVLI.—Larvæ in tank in the village.

KANDIVLI.—Adults in cowshed in Gauthan.

MANJAS.—Adults in cowshed and hut in Gauthan.

MAROL.—Adults in pucca house, and cowshed in Gauthan.

MOGARE.—Larvæ in Railway B. P. on the B.-B. & C. I. line.

OSHIWARA.—Larvæ in wells in S. No. 48 in the village.

(VILA PARLA RAILWAY STATION).—Larvæ in Railway B. P. near mile No. 16 west side ; 15 east side and west side ; 14 east side of B.-B. & C. I. Railway ; tank named Gaon Talav in the village.

(SANTA CRUZ RAILWAY STATION).—Larvæ in rice field in S. No. 377; Railway B. P. near mile No. 13 east side; 12 west side; 13 west side of B.-B. & C. I. Railway.

(BANDRA RAILWAY STATION).—Larvæ in Railway B. P. near mile No. 11 west side ; 10 west side ; 11 east side ; 10 east side of B.-B. & C. I. Railway ; well in house No. 14 ; well in S. No. 261 ; tank in the town.

MATMAULI (MOUNT MARY).—Larvæ in well in the village.

PALI HILL.—Larvæ in well in S. No. 264 in the village.

(KURLA RAILWAY STATION).—Larvæ in pools in S. Nos. 212 and 215 ; rice fields in S. Nos. 262 and 211, and 253 ; Railway B. P. on G. I. P. Railway line.

(GHATKOPAR RAILWAY STATION).—ANIK—Larvæ in tank in Gauthan ; wells in S. Nos. 4, 23 ; rice field in S. No. 20 ; pool in S. No. 75 in the village.

CHEMBUR.—Larvæ in pool in the village.

GHATKOPAR.—Adults in other building in Gauthan.

MAHUL.—Larvæ in rice fields in S. Nos. 2 and 66 ; stream east of S. No. 172 ; tank south of S. No. 179 in the village.

MAHN KHURD.—Larvæ in stream near S. Nos. 104 and 105 in the village.

MARAWALI.—Larvæ in tank south of Gauthan in the village.

NANALA.—Larvæ in well and rice fields and stream in the village.

(VIKHROLI RAILWAY STATION).—HARIYALI—Adults in hut and cowshed in Gauthan ; adults in cowshed in Gauthan.

PACHAKOLI.—Larvæ in pool in the village.

PAWAI.—Larvæ in tank of Pawai south side of the tank.

VIKHROLI.—Larvæ in rice fields ; well ; Tulsi Tank in the village.

(BHANDUP RAILWAY STATION).—Larvæ in well in S. No. 31; rice field in S. No. 39 in the village ; adults in cowshed in Gauthan.

KANJUR.—Larvæ in pool ; rice field in the village.

(MULUND RAILWAY STATION).—Adults in cowshed in Gauthan.

(THANA RAILWAY STATION).—BALKUMB—Larvæ in well in the village.

DHOKALE.—Larvæ in well in the village.

KAVESAR.—Adults in cowshed in Gauthan of Wagbilpada of the village.

KOPRI.—Larvæ in rice field in S. No. 36 of the village. Adults in cowshed in Gauthan.

MANJIVDA.—Adults in cowshed in Gauthan. Larvæ in rice fields of the village.

MANPADA.—Adults in cowshed in Gauthan.

NAVPADA.—Larvæ in rice field in S. No. 42 of the village. Adults in cowshed in Gauthan.

KOLSET.—Adults in cowshed at tari in the village.

THANA.—Larvæ in tank behind house No. 57 ; well in H. Nos. 131 and 132 tank named Makhwal ; well in H. No. 38 in the town.

WADHAWLI.—Larvæ in tank, well in the village ; adults in cowshed in Gauthan.

My. Jamesii was found at the following places :—

(BORIVLI RAILWAY STATION).—DAHISAR—Adults in cowshed in Gauthan.

KASHI.—Larvæ in rice field in S. No. 14.

MIRA.—Larvæ in rice field.

(KANDIVLI RAILWAY STATION).—AKURLI—Larvæ in Dhondlai Tank.

KANDIVLI.—Larvæ in rice field in S. No. 12.

(ANDHERI RAILWAY STATION).—ANDHERI STATION—Larvæ in Railway B. P.

(BANDRA RAILWAY STATION).—BANDRA—Larvæ in well.

(GHATKOPAR RAILWAY STATION).—GHATKOPAR—Larvæ in well in S. No. 1.

CHEMBUR.—Larvæ in salt pool.

MAHUL.—Larvæ in well in S. No. 1.

MARAVLI.—Larvæ in rice field.

(VIKHROLI RAILWAY STATION).—VIKHROLI—Larvæ in Vihad Tank and rice field.

PAWAI.—Larvæ in tank.

(BHANDUP RAILWAY STATION).—BHANDUP—Larvæ in tank. Adults in cowshed in Gauthan.

(MULUND RAILWAY STATION).—NAHUR—Larvæ in well and rice field.

(THANA RAILWAY STATION).—THANA—Larvæ in well.

WADHAVLI.—Adults in cowshed in Gauthan.

Py. Jeyporiensis was found at the following place :—

(BORIVLI RAILWAY STATION).—MAGATNA—Adults in cowshed in Gauthan.

N. Punctulata was found at the following places :—

(BHANDUP RAILWAY STATION).—Adults in cowshed in Gauthan.

(MULUND RAILWAY STATION).—Adults in cowshed.

(THANA RAILWAY STATION).—KOPRI—Adults in cowshed in Gauthan.

Ne. Stephensi was found at the following places :—

(MALAD RAILWAY STATION).—WALNAI—Adults in cowshed in Gauthan.

(ANDHERI RAILWAY STATION).—GONDIWALI—Larvæ in rice field in S. No. 21.

(GHATKOPAR RAILWAY STATION).—MARAWALI—Larvæ in pool.

(THANA RAILWAY STATION).—MANPADA—Adults in cowshed in Gauthan.

WADHAVLI.—Adults in cowshed in Gauthan.

My. Listonii was found at the following places :—

(BORIVLI RAILWAY STATION).—EKSAR—Adults in cowshed in Gauthan.

DAHISAR.—Larvæ in well in S. No. 249, and stream in S. No. 24, and rice field.

(KANDIVLI RAILWAY STATION).—POISAR—Larvæ in well in S. No. 5.

(MALAD RAILWAY STATION).—KURAR—Larvæ in wells in S. Nos. 11 and 30, and stream in S. No. 5.

CHARKOP.—Larvæ in well in S. No. 12.

WALNAI.—Larvæ in wells in S. Nos. 13 and 19.

(GOREGAON RAILWAY STATION).—Larvæ in Railway borrow-pit, mile No. 17, west side.

(ANDHERI RAILWAY STATION).—*Larvæ in well in S. No. 14.*

(VILA PARLA RAILWAY STATION).—*Larvæ in Railway borrow-pit.*

(SANTA CRUZ RAILWAY STATION).—Adults in building.

(BANDRA RAILWAY STATION).—Larvæ in well behind St. Joseph's Convent School.

MATMAULI—Larvæ in wells in S. Nos. 27, 271 and 282, and a well in Bungalow No. 38.

PALI HILL—Larvæ in wells in S. Nos. 161 and 325 and in Bungalow No. 6.

(VIKHROLI RAILWAY STATION).—TIRANDAJ—Larvæ in pool, and stream in Bhui Dongari.

(BHANDUP RAILWAY STATION).—Larvæ in well in S. No. 23.

KANJUR.—Larvæ in stream.

(THANA RAILWAY STATION).—Larvæ in wells in S. Nos. 3 and 127.

YEUR.—Adults in cowsheds in Gauthan.

My. Culicifacies was found at the following places :—

(BORIVLI RAILWAY STATION).—Larvæ in Railway borrow-pit, mile No. 22, and No. 21, west and east side, No. 20 east side ; and a well in S. No. 12.

DAHISAR.—Larvæ in wells in S. Nos. 29, 133, 254 and in Railway borrow-pit.

EKSAR.—Larvæ in well.

MIRA.—Larvæ in pool.

(KHANDIVLI RAILWAY STATION).—Larvæ in tank near S. No. 15.

AKURLI.—Larvæ in rice field.

POISAR.—Larvæ in rice field, and in well in S. No. 5.

WADHWAN.—Larvæ in well in S. No. 12.

(MALAD RAILWAY STATION).—Larvæ in wells in S. Nos. 1, 2 and 102.

ARE.—Adults in hut in Gauthan.

DINDOSHI.—Larvæ in well.

KURAR.—Larvæ in well in S. No. 5.

WALNAI.—Larvæ in well in S. No. 13.

(GOREGAON RAILWAY STATION).—Larvæ in Railway borrow-pit, mile No. 14, west side.

(ANDHERI RAILWAY STATION).—Larvæ in rice field in S. No. 809.

BRAHMANWADA.—Larvæ in well in S. No. 3.

CHAKALA.—Larvæ in well in S. No. 46.

MOGRA.—Larvæ in Sarkari well.

OSHIWARE.—Larvæ in pool in S. No. 48.

(VILA PARLA RAILWAY STATION).—Larvæ in Railway borrow-pit, mile No. 14, east side; and in wells in S. Nos. 241, 245 and 247.

(SANTA CRUZ RAILWAY STATION).—Larvæ in wells, Railway borrow-pit, and in well in S. No. 114.

(BANDRA RAILWAY STATION).—Larvæ in well in S. No. 261, and in Railway borrow-pit, mile No. 10, west side.

PALI HILL.—Larvæ in wells in S. No. 325.

MATMAULI.—Larvæ in wells in S. Nos. 270, 281 and 282.

(KURLA RAILWAY STATION).—Larvæ in well.

(GHATKOPAR RAILWAY STATION).—Larvæ in tank and rice field, in S. No. 185.

VADHAVLI.—Larvæ in well in S. No. 55.

ANIK.—Larvæ in stream.

MAHAL.—Larvæ in stream to the north of S. No. 151.

NANALA.—Larvæ in stream.

(VIKHROLI RAILWAY STATION).—Larvæ in wells.

HARIYALI.—Adults in cowshed in Gauthan.

TIRANDAJ.—Larvæ in well and stream.

(BHANDUP RAILWAY STATION).—Larvæ in Railway borrow-pit, mile No. 14-15, and in well in S. No. 3 and some others; adults in pucca house in Gauthan.

KANJUR.—Larvæ in well.

(MULUND RAILWAY STATION).—Larvæ in well in S. No. 30 and in rice fields, in S. Nos. 16 and other in Gawhanpada; adults in cowshed in Gauthan of Nawagharpada.

NAHUR.—Larvæ in well, pool in S. No. 102, and stream in S. No. 1.

(THANA RAILWAY STATION).—Larvæ in wells in houses Nos. 3 and 194, and in other wells and stream.

DHOKALE.—Larvæ in well.

MANJIVDA.—Adults in cowshed.

MANPADA.—Larvæ in wells.

NAVPADA.—Larvæ in Railway borrow-pit.

APPENDIX II.

Table of villages in alphabetical order in which anopheline larvæ and adult were found :—

AKURLI.—*My. Culicifacies* larvæ in rice field; *Ny. Jamesii* larvæ in tank named Dhondlai; *My. Fuliginosus* larvæ in pool, and well; *My. Fuliginosus* adults, hut and cowshed in Gauthan.

ANDHERI.—*My. Listonii* larvæ in well in S. No. 14, tank in S. No. 81, rice fields in S. Nos. 81 and 809; *My. Barbirostris* adults, cowsheds in S. Nos. 9 and 12.

ANIK.—*Ny. Fuliginosus* larvæ in tank in Gauthan; *My. Culicifacies* larvæ in stream; *Ny. Fuliginosus* larvæ in wells in S. Nos. 4 and 23; pool in S. No. 75; rice fields in S. No. 20.

AMBIVLI.—*M. Barbirostris* adults, cowshed.

ARE.—*Ny. Fuliginosus* adults, huts and cowshed in Gauthan; *My. Listonii* adults, cowshed in Gauthan; *M. Barbirostris* adults, cowshed in Gauthan; *My. Culicifacies* adults, hut in Gauthan.

BALKUM B.—*Ny. Fuliginosus* larvæ in well.

BANDIVLI.—*M. Barbirostris* larvæ in wells in S. Nos. 1, 17 and 19; tank in S. Nos. 24 and 25; *Ny. Fuliginosus* larvæ in tank in S. Nos. 24 and 25, pools in S. Nos. 24 and 41, well in S. No. 17.

BANDRA (SEE ALSO MATMAULI AND PALI HILL).—*M. Barbirostris* larvæ in wells S. Nos. 189, 197, 198, 204, 223, 230, 235, two in 239, 240 and 241, one in Gauthan, in one in Bungalow No. 40, one in Municipal school No. 1, one in Rangari's chawl, one at right hand side of St. Joseph Convent School, and 5 wells, and one pool in S. No. 241 ; *Ny. Fuliginosus* larvæ in well in S. No. 261, one in house No. 14, and one tank; *My. Culicifacies* larvæ in well in S. No. 261 ; *Ny. Jamesii* larvæ in well ; *My. Listonii* larvæ in well at side of St. Joseph Convent School ; *M. Barbirostris* adults in cowshed in Gauthan.

BHANDUP.—*Ny. Fuliginosus* larvæ in well in S. No. 31 ; rice field in S. No. 39 ; adults in cowshed in Gauthan ; *My. Culicifacies* larvæ in well in S. No. 3, well of khot, well of Mahar ; adults in pucca house in Gauthan ; *Ny. Jamesii* larvæ in tank, adults in cowshed in Gauthan; *My. Listonii* larvæ in well in S. No. 23; *N. Punctulata* adults in cowshed in Gauthan.

BORIVLI.—*Ny. Fuliginosus* larvæ in tank; *My. Culicifacies* larvæ in well in S. No. 12, and one well.

BAMANVADA.—*Ny. Fuliginosus* larvæ in well in S. No. 54, in tank; adults in cowsheds in Gauthan; *My. Culicifacies* larvæ in well in S. No. 3.

CHAKALE.—*M. Barbirostris* larvæ in rice field in S. No. 39; *Ny. Fuliginosus* larvæ in rice field in S. No. 39; tank in S. No. 48; adults in cowsheds in Gauthan; *My. Culicifacies* larvæ in well in S. No. 46.

CHARKOP.—*M. Barbirostris* larvæ in well in S. No. 12; *My. Listonii* larvæ in well in S. No. 12.

CHEMBUR.—*Ny. Fuliginosus* larvæ in pool : *My. Jamesii* larvæ in salt pool.

DAHISAR.—*M. Barbirostris* larvæ in two wells in S. No. 133; *Ny. Fuliginosus* adults in cowshed in Gauthan; *My. Culicifacies* larvæ in wells in S. Nos. 133, 29 and 254 and one well; *My. Listonii* larvæ in well in S. No. 249, and one well, stream near S. No. 24; *Ny. Jamesii* adults in cowshed in Gauthan.

DHOKALE.—*M. Barbirostris* larvæ in wells; adults in cowshed in Gauthan; *Ny. Fuliginosus* larvæ in one well; *My. Culicifacies* larvæ in well.

DINDOSHI.—*My. Culicifacies* larvæ in well.

EKSAR.—*Ny. Fuliginosus* larvæ in ricefield in S. No. 20; tank in S. No. 202; *My. Culicifacies* larvæ in well; *My. Listonii* adults in cowshed in Gauthan.

GHATKOPAR.—*Ny. Barbirostris* adults in cowshed in Gauthan; *Ny. Fuliginosus* adults in building in Gauthan; *My. Culicifacies* larvæ in tank, rice field in S. No. 185 ; *Ny. Jamesii* larvæ in well in S. No. 1.

GONDIVLI.—*Ny. Fuliginosus* larvæ in tank; *Ne. Stephensi* larvæ in rice field in S. N. 21.

GOREGAON.—*Ny. Fuliginosus* larvæ in well in S. No. 24, tank in S. No. 100.

HARIYALI.—*M. Barbirostris* adults in cowshed in Gauthan; *Ny. Fuliginosus* adults in hut and cowshed in Gauthan; *My. Culicifacies* adults in cowshed in Gauthan.

KHANDIVLI.—*Ny. Fuliginosus* larvæ in rice field in S. No. 12, tank in S. No. 15; adults in cowshed in Gauthan; *My. Culicifacies* larvæ in tank in S. No. 15; *Ny. Jamesii* larvæ in rice field in S. No. 12.

KANJUR.—*Ny. Fuliginosus* larvæ in rice field, in pool; *My. Culicifacies* larvæ in well; *My. Listonii* larvæ in stream.

KASHI.—*M. Barbirostris* larvæ in well in S. No. 95, rice fields in S. Nos 3 and 6, adults in cowshed in Gauthan; *Ny. Fuliginosus* adults in cowshed in Gauthan; *Ny. Jamesii* larvæ in rice field in S. No. 14.

KAVESAR.—*M. Barbirostris* adults in cowshed in Gauthan; *Ny. Fuliginosus* adults in cowshed in Gauthan of Waghilpada.

KIROL.—*M. Barbirostris* adults in pucca house in Gauthan.

KOLSET.—*Ny. Barbirostris* larvæ in tank, wells in S. Nos. 247 and 268, well in S. No. 10 of Tarichapada; *Ny. Fuliginosus* adults in cowshed in Gauthan of Tarichapada.

KONDIVTA.—*Ny. Fuliginosus* adults in cowsheds in Gauthan.

KOPRI.—*Ny. Barbirostris* adults in cowshed in Gauthan; *Ny. Fuliginosus* larvæ in rice field in S. No. 36, adults in cowshed in Gauthan; *N. Punctulata* adult in cowshed in Gauthan.

KURLA.—*Ny. Fuliginosus* larvæ in rice fields in S. Nos. 211, 253 and 262, pool in S. Nos. 212 and 215; *My. Culicifacies* larvæ in well.

KURAR.—*M. Barbirostris* larvæ in well in S. No. 11; *Ny. Fuliginosus* larvæ in tank in S. No. 3; *My. Culicifacies* larvæ in well in S. No. 5; *My. Listonii* larvæ in well in S. No. 11; streams in S. Nos. 5 and 30.

MAGATNA.—*Ny. Fuliginosus* adults in cowshed in Gauthan; *Py. Jeyporiensis* adults in cowshed in Gauthan.

MAHUL.—*Ny. Fuliginosus* larvæ in rice fields in S. Nos. 2 and 66, in tank to the south of S. No. 179, in stream to the east of S. No. 172; *M. Barbirostris* larvæ in wells of S. Nos. 139 and 147; *My. Culicifacies* larvæ in stream to the north of S. No. 151; *Ny. Jamesii* larvæ in well of S. No. 1.

MANJIVDA.—*My. Culicifacies* adults in cowshed; *M. Barbirostris* adults in cowshed in Gauthan; *Ny. Fuliginosus* adults in cowsheds and larvæ in rice fields.

MALAD.—*My. Culicifacies* larvæ in wells of S. Nos. 1, 2 and 102; *Ny. Fuliginosus* adults in cowsheds in Gauthan, larvæ in well and in rice field in S. No. 106; *M. Barbirostris* adults in cowshed in Gauthan.

MALAVNI.—*M. Barbirostris* larvæ in well in S. No. 12 and other well; *Ny. Fuliginosus* larvæ in tank to the east of S. No. 99, and in wells of S. Nos. 50, 64 and 84.

MARAWALI.—*M. Barbirostris* larvæ in well; *Ny. Fuliginosus* larvæ in tank *My. Jamesii* larvæ in rice field; *No. Stephensi* larvæ in puddle.

MATMAULI (MOUNT MARY OR BANDRA HILL).—*M. Barbirostris* larvæ in wells of S. Nos. 27, 271, 282, 270, 281, 282, 270, 246, 268, 281, 280, and in wells of houses Nos. 4, 38 and 81; *Ny. Fuliginosus* larvæ in well; *My. Culicifacies* larvæ in wells of S. Nos. 281, 282 and 270; *My. Listonii* larvæ in wells of S. Nos. 27, 271, 282 and a well of bungalow No. 38.

MANJAS.—*M. Barbirostris* adults in cowshed in Gauthan; *Ny. Fuliginosus* adults in cowshed and hut of Gauthan.

MAHN KHURD.—*M. Barbirostris* larvæ in wells of S. Nos. 58, 91 and 88; *Ny. Fuliginosus* larvæ in stream.

MANPADA.—*M. Barbirostris* larvæ in well; *Ny. Fuliginosus* adults in cowshed of Gauthan; *My. Culicifacies* larvæ in well; *Ne Stephensi* adults in cowshed in Gauthan.

MAROL.—*M. Barbirostris* adults in cowshed in Gauthan; *Ny. Fuliginosus* in house and cowshed in Gauthan.

MIRA.—*M. Barbirostris* larvæ in Dhobidai stream and Chari Tank and in rice fields, adults in cowshed in Gauthan; *Ny. Fuliginosus* larvæ in puddles and tank, adults in cowsheds in Gauthan, in streams, in tank and in rice field; *My. Culicifacies* larvæ in Sarkari well, puddle and rice field; *Ny. Jamesii* larvæ in rice field; *My. Listonii* larvæ in rice field.

MULUND.—*Ny. Fuliginosus* adults in cowsheds in Gauthan; *My. Culicifacies* larvæ in well in S. No. 30 and in rice field in S. No. 16, adults in cowshed in Gauthan.

NAHUR.—*My. Culicifacies* larvæ in well, stream in S. No. 1, puddle in S. No. 102; *Ny. Jamesii* larvæ in well and rice field.

NAUALA.—*M. Barbirostris* larvæ in rice fields; *Ny. Fuliginosus* larvæ in rice fields, in well and in stream; *My. Culicifacies* larvæ in streams.

NAVPADA.—*Ny. Fuliginosus* larvæ in rice field in S. No. 42, adults in cowsheds in Gauthan; *N. Punctulata* adults in cowshed in Gauthan.

OSHIVRA.—*Ny. Fuliginosus* larvæ in well in S. No. 48; *My. Culicifacies* larvæ in puddle in S. No. 48.

PACHAKOLI.—*M. Barbirostris* larvæ in puddle; *Ny. Fuliginosus* larvæ in puddle.

PAHADI.—*Ny. Fuliginosus* adults in cowshed in Gauthan.

PALI HILL.—*M. Barbirostris* larvæ in well in S. No. 325; *Ny. Fuliginosus* larvæ in well in S. No. 264; *My. Culicifacies* larvæ in wells in S. No. 325; *My. Listonii* larvæ in wells in S. Nos. 6, 161 and 325.

PAVAI.—*Ny. Fuliginosus* larvæ in tank; *Ny. Jamesii* larvæ in tank.

POISAR.—*M. Barbirostris* larvæ in well, adults in cowshed in Gauthan; *Ny. Fuliginosus* larvæ in puddle and in stream S. No. 5; adults in house and cowshed in Gauthan; *My. Culicifacies* larvæ in well in S. No. 5 and rice field; *M. Listonii* larvæ in well in S. No. 5.

SANTA CRUZ.—*Ny. Fuliginosus* larvæ in rice field in S. No. 377; *My. Culicifacies* larvæ in well in S. No. 114 and others; *My. Listonii* adults in building in Gauthan.

THANA.—*M. Barbirostris* larvæ in wells in S. Nos. 56, 122, 194, 127, and in rice field in S. No. 6; *Ny. Fuliginosus* larvæ in wells in S. Nos. 38, 132, 131, and in tanks, one named Mahhamel and the other behind H. No. 57; *My. Culicifacies* larvæ in wells in Patawai No. 3 in H. No. 194 and some others and in stream; *Ny. Jamesii* larvæ in well; *My. Listoni* larvæ in wells in S. Nos. 127 and 3.

TIRANDAJ.—*My. Culicifacies* larvæ in well and stream; *My. Listonii* larvæ in stream and puddles.

VADHVAN.—*My. Culicifacies* larvæ in well in S. No. 12.

VALNAI.—*M. Barbirostris* larvæ in tank called Khandala and in tank in S. No. 10; *Ny. Fuliginosus* larvæ in rice field in S. No. 14, adults in cowshed in Gauthan; *My. Culicifacies* larvæ in well in S. No. 13; *My. Listonii* larvæ in wells in S. Nos. 13 and 19; *Ne. Stephensi* adults in cowshed in Gauthan.

VIKHROLI.—*Ny. Fuliginosus* larvæ in well, tank, and rice field; *My. Culicifacies* larvæ in wells; *My. Jamesii* larvæ in rice-field, Vihad Tank and other tank.

VILA PARLA.—*Ny. Fuliginosus* larvæ in tank; *My. Culicifacies* larvæ in wells in S. Nos. 245, 241, and 247.

WADHAVLI IN TROMBAY.—*M. Barbirostris* larvæ in puddle and in well in S. No. 2; *Ny. Fuliginosus* larvæ in well and tank; *My. Culicifacies* larvæ in well and in stream in S. No. 55.

WADHAVLI near THANA.—*Ny. Fuliginosus* adults in cowshed in Gauthan; *Ny. Jamesii* adults in cowshed in Gauthan; *Ne. Stephensi* adults in cowshed in Gauthan.

WYARAWALI.—*M. Barbirostris* adults in hut in Gauthan.

YEUR.—*My. Listonii* adults in cowsheds in Gauthan.

APPENDIX III.

Apparatus used for the capture and development of larvæ.

The Salsette enquiry afforded a pretty extended opportunity for testing the relative usefulness of different forms of apparatus that have been used or suggested for use elsewhere, and finding out the best way of using those that were found to be really practical. The following were found the best to use :—

Dr. Bentley's Well-Net.—This is described in Dr. Bentley's Report on Malaria in Bombay. A substitute, which does not fold up like the original, was obtained for the Salsette investigation through the Malaria Assistant to the Health Officer, Bombay Municipality, from a Borah named Hassan Ali Abdul Ali. The well-net is absolutely indispensable, and even with its use larvæ will be missed if Dr. Bentley's directions about inverting the net and washing it are not followed in every case.

Bucket.—This is needed to bring up some of the water of each well to wash the larvæ out of the net. If the rest of the kit is to be carried in it the bucket should be as large as possible; otherwise the smaller it is the better.

Enamelled Frying-Pan.—This was introduced by Dr. Bentley merely to wash the net, but in the Salsette enquiry it proved to be by far the most useful vessel for catching larvæ in tanks and streams, as the width of the sweep one can give with it enables such a large surface of water to be examined at a time, and as it can stand rough usage so well, when the bottom of a stream is being examined.

Long Enamelled Spoon.—This is chiefly of use in skimming the larvæ from the water in the frying-pan, but it is also useful in examining hoof-prints and other small hollows containing water.

Enamelled Mug.—The two latter articles suffice for nearly every open place, but a mug is needed for work in rice fields and places where long grass stands in water.

Quinine Bottle.—Both for carrying in the field and for keeping the larvæ in afterwards to hatch out, the most useful bottles to use are ounce of quinine bottles, which are obtainable easily in the bazaar. These are cylindrical bottles of seven fluid ounce capacity, and the most suitable ones are those which have a broad flange on the lip. Each should be fitted with a string round the neck to which to fix another loop of string, like the handle of a basket, to carry the bottle by. The cap of the bottle is best made of a little square of coarse *dangri* or *khadi* cloth, tied to the string on the neck by a thread a couple of inches long. This cloth is of open texture, and allows free access of air. To the upper surface of the cap, near one edge, should be sewn a loop of silk elastic. If the cap is laid on the mouth of the bottle it can be fixed on in a second by laying the forefinger of the left hand, which holds the bottle, on the insertion of the loop, against the neck, and slipping the loop down over the mouth with the right hand. The bottles are carried in the field with the caps hanging down. Each is capped as soon as it is filled, without the aid of any string. A good rule to make is that, once it is capped, no bottle is to be opened, except by the Malaria Officer himself.

Each bottle has a label, bearing simply a serial number in English and in the vernacular, which is written on it when the day's batch of bottles is being issued, and which corresponds with a number in the register. The bottles are carried in a wooden box or tray with compartments, which has a handle rising from the middle compartment, and as each is filled and capped the searcher enters the number in the margin of his note-book, and opposite this makes a note of the kind of collection of water the larvæ were taken from, and the village survey number, or other means of identification of the place. At the end of the morning's or evening's search the bottles are returned to the laboratory, and the notes copied from the searcher's note-book into the register, opposite the serial numbers. If carbons are used with the note-books individual searchers need not attend the laboratory; they tear out the pages and send them in with the bottles. The bottles are examined as soon as the Malaria Officer has time to attend to them and then write up his part of the register. In Salsette the register was kept somewhat in the following fashion:—

Serial number.	Date	Rice field.	Well.	Tank.	Cistern.	Puddle.	Saltpan.	Railway Borrow-Pit.	Stream.	Swamp.	Locality.	Ny. fuliginosus.	N. rossii.	My. culicifacies.	Ny. Jamesii.	My. Listonii.	M. Barbirostris.	No. Stephensi.	Remarks.	Identified by larvæ imago.
457	5th Oct 1912	..	1	..	..	..	..	..	..	..	S. N. 271 Mount Mary.	..	..	..	..	1	1	..	Listonii has branched frontal hairs as in Bentley.	l=I
58	Do	..	..		..	..	..	..	..	..	Ganthan of Akurli.	1	..	..	..	..	..	..		b=L I

As the examination of the contents of each bottle is finished and the result registered the number on its label is heavily crossed out with blue pencil. The peon in attendance, who recognizes this marking, removes the bottle, rinses it out, and fixes on a new blank label, and the bottle, with its cap and elastic hanging from it, is placed in the stock for re-issue with a fresh serial number.

Although it pays to keep the specimens for several days, to let as many adults develop as possible, it is seldom worth the trouble to change the water in the bottles; as a rule if larvæ will not develop in their own water they will not do so in any other. In Salsette it was found that a greater proportion of specimens yielded adults when kept standing in the dry weather after the monsoon than during the wet weather itself.

However many bottles have accumulated on the shelves, with only the numbers on them to distinguish them, if a rule is observed that only one bottle is allowed to have its cap off at one time no mistake in identity can occur, even if the Malaria Officer is called away in the middle of examining larvæ or adults taken out of a bottle.

A stylo pen pipette is useful for taking out larvæ for examination under the microscope.

When adults have developed in a bottle, if it is desired to mount them without chloroforming them *in situ*, which would wet them, and kill the remaining larvæ in the bottle, they may be transferred to a dry bottle in the following way; to let any escape should be considered bad technique:—

Hold the wet bottle in the left hand, with the forefinger and thumb forming a ring round the neck, and pressing the margins of the cap against the glass. Slip off the elastic band inserted on the cap. Invert a dry bottle, with its cap hanging off, over the wet one, and clasp both bottles with the right hand. With the left pull off the cap of the wet bottle sideways from between the two mouths, and let it hang. The mosquitoes will fly up into the dry bottle. If any are sluggish the lower bottle may be bumped on the table, or tilted so that the water touches their hind legs. When all have flown up and been counted lay the cap of the dry bottle on the palm of the left hand, slip the still inverted bottle rapidly on to it, and adjust the elastic before turning the bottle up. Then copy the number of the wet bottle on to the label of the dry.

A window-sill is a convenient place for this dry bottling.

The following directions to those who are to collect the larvæ are only for the using of the kit described above, and are intended to supplement the general instructions which are usually given. The use of Dr. Bentley's well-net is described on page 69 of his report, so directions for this are not given here.

Directions given to searchers.

For field work the following should be taken:—A well-net, a bucket, a frying-pan, a long spoon, a mug, a boxful of quinine bottles and a note-book with carbon sheet and pencil. The mug, the spoon and pan should each have a loop of string fixed to its handle. When a tank or stream is to be examined, the pan, the spoon and a bottle, with its cap hanging down, should be taken from the cooly, and the spoon and the bottle hung from the third and fourth fingers of the left hand. Nothing is to be put on the ground. The water should be considered to be in three layers or levels, the surface at which the larvæ may be feeding, the middle, in which they may be concealed in green weed, and the bottom, on which they may be resting. The surface should first be skimmed with the pan. After each sweep the pan should be held at rest, and examined, plenty of time being given to allow the larvæ to come to the surface. If any are seen the pan should be grasped at the side opposite the handle with the thumb and first two fingers of the left hand, while the spoon is taken off the third finger with the right hand. Held like a pen, it is used to skim the larvæ off the surface and pour them into the bottle which hangs from the little finger.

If the bottle gets too full of water before there are many larvæ in it the water may be partly poured away by bridging the mouth of it with the forefinger at one side and cautiously tilting the bottle in that direction. The water runs away under the finger, while the larvæ at the surface are not disturbed.

The " middle layer " of the water of the tank or stream should then be examined, if there is green weed present, piece after piece of it being brought up in the pan. If no larvæ come out of the weed to the surface of the water in the pan the weed should be squeezed like a sponge with the hand under water.

Lastly, the bottom should be examined, and stirred up with the pan, the surface water being then skimmed for the larvæ that may have come up when disturbed.

The cooly may meanwhile employ himself in searching for larvæ with the mug.

The larvæ of not more than one tank, well or stream may be put into one bottle, though a chain or rice fields or borrow-pits may be considered as one. When enough larvæ have been secured the cap is to be fixed on with the elastic, and the bottle given back to the cooly. The number of the bottle, and a short description of the

piece of water from which the larvæ were taken, with the name of the village, and if possible the survey number, should be entered in the note-book, before the cooly replaces the bottle in its compartment of the box.

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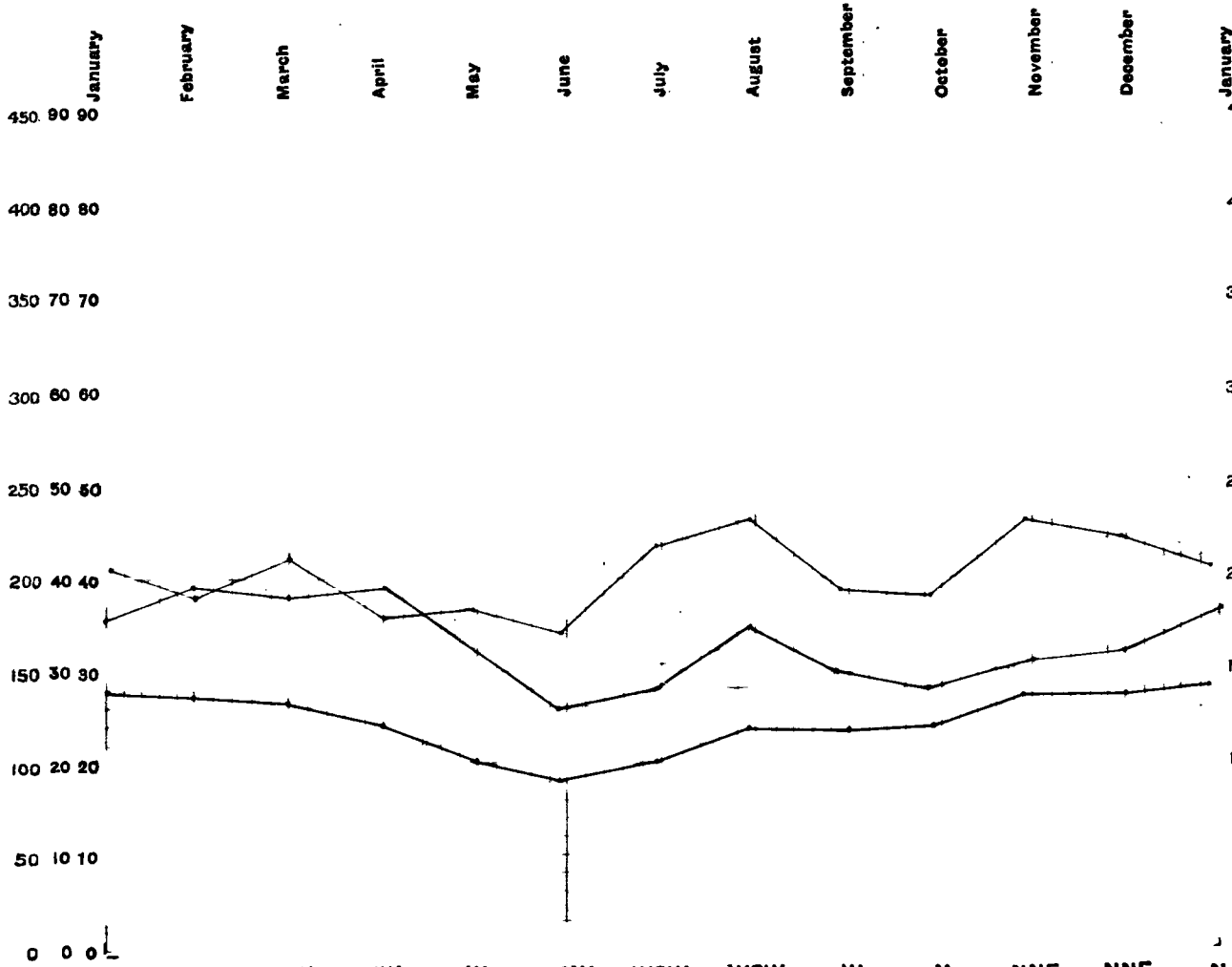


N	N	NNW	NW	W	WSW	WSW	WSW	W	N	NNE	NNE	N
50	60	50	60	70	70	85	85	55	20	50	55	50
6·1	6·7	7·3	7·4	5·9	8·7	9·4	10·8	6·9	5·3	5·4	5·9	6·1

SALSETTE TALUKA

CHART No. 1

SHOWING

The mean annual death-rate per mille of population for the ten years 1901-1910 for each month (black curve)

The same rate minus the death-rates from Small-pox, Plague, Cholera and Dysentery and Diarrhœa (green curve)

and

The mean annual death rate of children under one year per mille of Mean Annual births for the ten years 1901-1910 for each month (red curve)

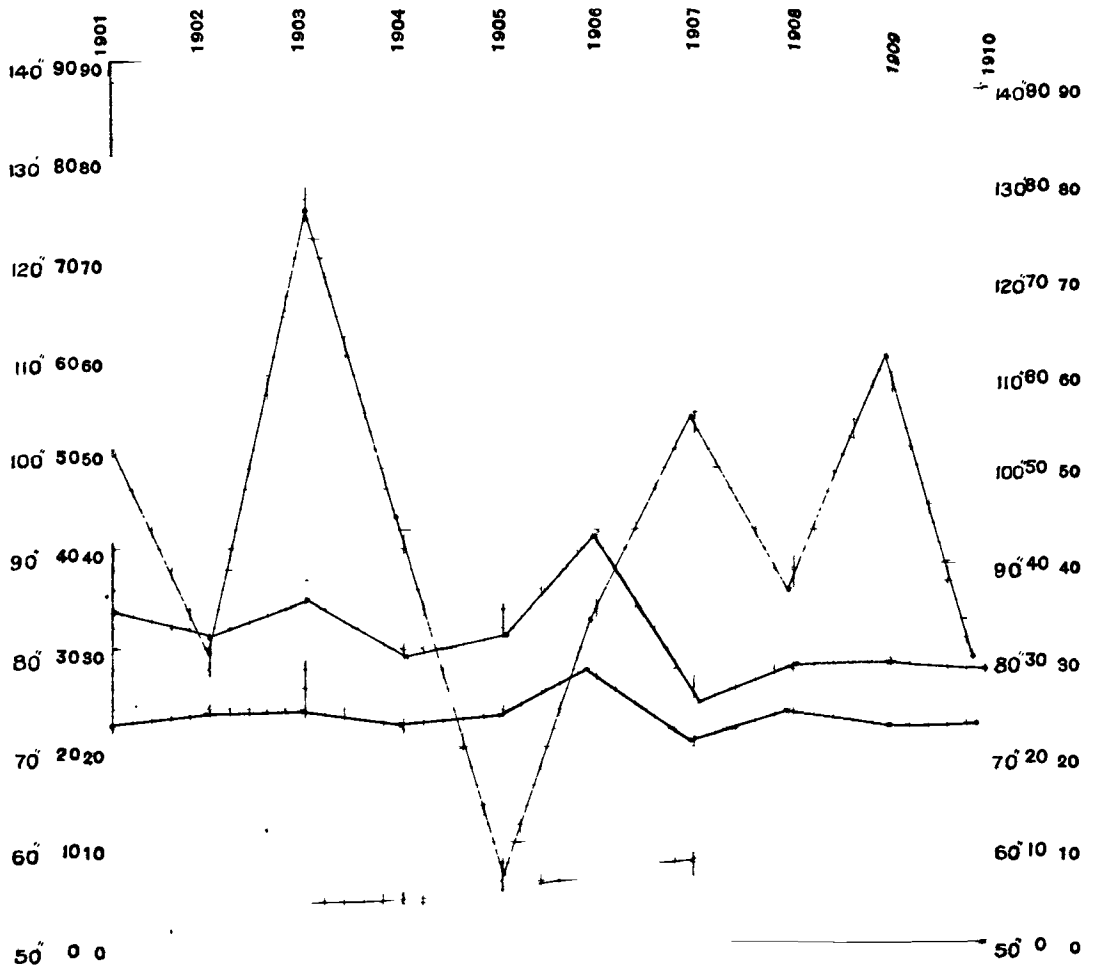
(Corrected for the number of days in the month)

ALSO

Normal mean wind direction at Bombay Observatory (Black letters

Normal mean wind steadiness at Bombay Observatory (Black figures)

Mean wind velocity in miles per hour at Bombay Observatory (for one year only). (Red figures)



SALSETTE TALUKA

CHART No. 2

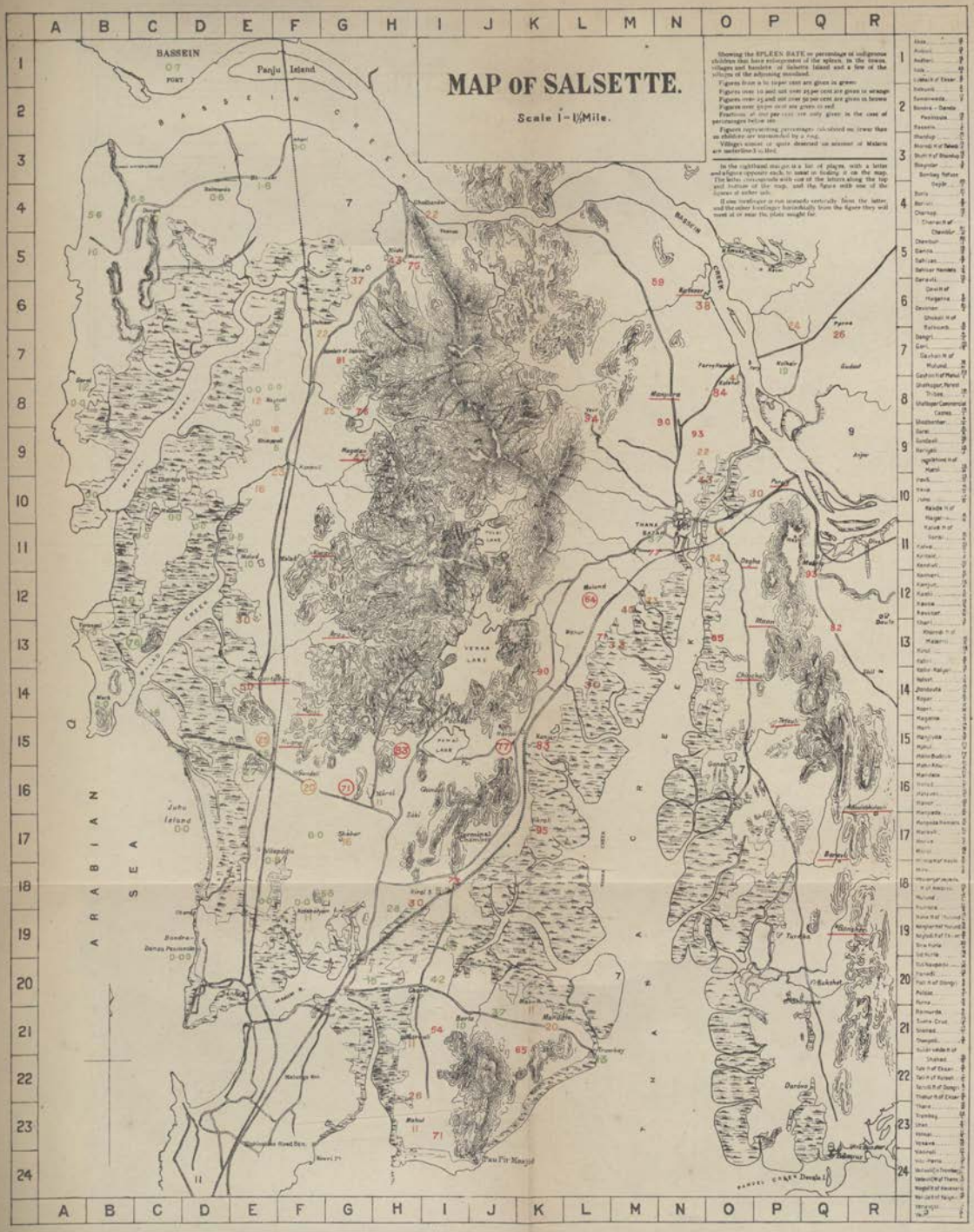
SHOWING

The annual death-rate permille for the year 1901-1910 (Black curve)

The same annual death-rate less the death-rates from Small-Pox, Plague, Cholera and Dysentery and Diarrhœa (Green curve)

and

The total annual rain-fall registered at Thana town for the years 1901-1910 (Red curve)


MAP OF SALSETTE.
Scale 1-1½ Mile.
BASSEIN
Panju Island
ARABIAN SEA
THANA CREEK
VERNA LAKE
Juhu Island
Bandra-Danes Pasturage
Sion Fir Masjid
Dharavi
Kurla
Mahul
Powai
Vihar
Tulsi
Mulund
Thana
Kalwa
Mumbra
Dongri
Ghatkopar
Andheri
Versova
Malad
Borivli
Dahisar
Kanheri
Tirmul
Kalyan
Bhiwandi
Vasind
Shahad
Ambivli
Titwala
Vehloli
Wada
Kasara
Igatpuri

MALARIA AND RICE CULTIVATION

BY

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IN 1912 the General Malaria Committee passed a resolution pointing out the desirability of ascertaining the precise conditions under which rice cultivation is, or is not, likely to be harmful, and the following is an account of the conditions prevailing in the rice-growing areas of the Central Provinces.

As local conditions may act in modifying the results, it will be necessary, first of all to mention the physiographical and economical characteristics of the rice tracts of these Provinces, then to specify the malarial conditions, and lastly by means of vital statistics to show the effect of this form of cultivation upon the health of the population.

The area under rice cultivation in these Provinces in the year 1904 was over 7,000 square miles, and it has been increasing yearly since then (the increase in 1912 was 2 per cent.)

The great bulk of the rice (*oryza sativa*) is produced in the Chhattisgarh districts of Raipur, Drug and Bilaspur, and in the Wainganga districts of Bhandara, Balaghat, Chanda, and parts of Nagpur and Seoni.

The physical features of this rice tract are characteristic, an extensive plain covered by small embanked rice fields comprising the basins of the Wainganga and Mahanadi rivers, bounded on the north, east and south by hilly country with a belt of hill and jungle separating the valley of the Wainganga from the Chhattisgarh plains. Low undulations of unculturable gravel traverse the plain in places, otherwise it is unbroken except for small patches of scrub jungle and mango groves. On the borders, where the hilly country merges into the plains, the cultivated area becomes irregular and broken up by encroaching forest. The soil is largely of a yellow sandy nature, formed from metamorphic or crystalline rock.

The rivers of this area, the chief ones being the Wainganga and the Mahanadi, have their sources and the greater part of their catchment basins at a considerable elevation above the sea ; during their course through the plains they have cut for themselves beds, at a considerable depth below the surface of the country which they drain. Except during the rainy season, they consist merely of a series of stagnant pools, connected by a streamlet flowing along one side of a broad expanse of sand.

Tanks constructed for drinking purposes and for the irrigation of rice are exceedingly numerous, there being one or more in the neighbourhood of every village. There are said to be 28,500 tanks in the Wainganga area, and 18,500 in the Chhattisgarh. The majority of the tanks contain water weeds, and grass, and severa varieties of fish (*Barbus cochonius, Danio devario, &c.*)

The climate is hot and dry, except during the rains ; in May the heat is extreme, the temperature often reaching 114 or 115 degrees, while on clear nights it falls to 80°. During the rains the highest day-temperature seldom rises above 95° ; in the cold season the highest temperature is between 80° and 90°, and the lowest about 50°, on the whole except during the intense heat of April, May and June and the moist steamy atmosphere of September, the climate is not unpleasant.

The mean rainfall in the rice area is 53 inches, the monsoon generally breaks about June 10th and ceases during the first or second week in October. With the exception of a few inches during the cold weather, all the rainfall is confined to the monsoon months, the distribution being as follows:—June, 9 inches; July, 16; August, 13; September, 8½; October 2½.

The method of cultivation is almost universally " broadcast sowing," transplantation being practised in a few places only. The land having been well manured, is usually ploughed and sown at the break of the rains (*batar*), then when the fields are full of water and the young rice plants have attained the height of a foot or so (end of July), thinning is effected by ploughing at right angles (*biasi*). The irregularities and exposed roots are subsequently pressed back into the soil by the substitution of a log of wood for the plough (*koper*). Some of the water is then

run off the fields and they are left in readiness for the mid-August fall of rain. The field sluices are not again opened except in the case of very excessive rain, or for the purpose of irrigation, until the latter half of October. Weeding is carried out twice or oftener. Rice is grown year after year without rotation, and has many varieties, which are broadly divided into light rice, sown on uplands, medium on level ground, and heavy rice on low-lying and irrigated fields. The lighter varieties are reaped at the end of October, but harvesting of the heavier kinds goes on well into December.

Irrigation is merely additional to the rainfall, and is thus more frequently resorted to where light, non-retentive soils predominate. The sources of supply are almost entirely private tanks, the area irrigated by the State being 28,319 acres only. The total area irrigated fluctuates considerably from year to year, but on an average it is about 1,200 square miles or 17 per cent. of the rice growing country. Practically in every village area there is some irrigation from tanks or rivers, in some districts with large tanks the channels are of fair depth and width, and more than a mile in length. Channels of this nature being used year after year, become lined with a plentiful growth of water weeds. In other places, *e.g.*, on the irregular, partially cleared tracts near the hills, a temporary, an insignificant mud drain suffices to conduct the water from tank to field. Often a considerable number of fields lying below the bund of a tank are irrigated by filtration and leakage.

The population of the rice tracts of these Provinces numbered 5,287,000 at the last census (1911). It is significant that the population increased during the last ten years by 20 per cent. The average density of population in the open plains varies from 200 to 280 per sq. mile ; on the borders of this tract where cultivated areas are interrupted by hill and forest the density may fall as low as 70 to the sq. mile. 972 per mille of the population reside in villages, the average population of each of which is 294 persons ; each house contains an average of 5 occupants.

Malaria and Rice.

With a view to ascertain the extent to which rice cultivation is associated with malaria, I carried out a survey of the western or Wainganga Basin in 1910-11, and of the eastern or Chhattisgarh Plain in 1913, my assistants conducting investigations in the districts of Chanda, Drug, and part of Raipur. Without entering into too great detail, I will mention some of the results and conclusions arrived at. An examination of over 30,000 children between the ages of two and ten years throughout this rice country, suggests that from the point of view of malarial endemicity, the area should be divided into a healthy area with a spleen rate under 10 per cent., an endemic area with the rate between 10 and 50 per cent., and a hyper-endemic area with a rate above 50 per cent.

The healthy area comprises nearly the whole of the open plains country. The following table gives the result of the spleen examination of the children :—

No. of villages.	Total No. of children examined.	No. with enlarged spleen.	No. with no enlargement.	Spleen rate.
206	12,384	537	11,847	4·3

This area is closely cultivated and almost devoid of forest, a large part of it is marked by gently undulating slopes of light yellow soil, gravel or laterite, with broad shallow intervening valleys of richer soil, capable of growing the finest crops without the aid of irrigation.

From an elevation one can see the country around for miles, consisting of an endless succession of small rice fields with narrow earth banks, from one to three feet high, between. Dotted about are the villages, conspicuous by their tanks and groves of Mango, Pipal, and Tamarind trees. Except for these groves, and roadside foliage, trees are scarce, but occasionally patches of waste land are found covered with thorn or scrub. Innumerable water-courses intersect the country in every direction, but except for a small stagnant pool here and there, most of them remain dry from November until the following rains. Throughout the whole area there are many rivers, large and small, most of which hold water the entire year, either in the form of a chain of pools or a narrow sluggish stream. The villages are commonly surrounded by rice fields (which remain flooded until October 15, or later) right up to the doors of the houses ; within a stone throw is a good sized tank containing often clear water and covered to a considerable extent by Water Lilies (*Nelumbium speciosum*), Singhara, Chela (*Chara sp.*), and other weeds. A large number of cattle are stalled in each village and the cattle shed is built against the side of the house, and considered part of it. The houses are generally mud-walled, occasionally wattle and daub, with a thatch or bamboo-matting roof.

The anophelines found in this area are the following species:—

A fuliginosus, A. fowleri, A. culicifacies, A. rossi, A. sinensis, A. maculipalpis, A. barbirostris, A. punctulata.

A. fuliginosus is the commonest species throughout the year, the female feeds mainly upon cattle and is always found in or near cattle sheds, the chief breeding-places are the tanks and borrow-pits, more especially those containing fairly clear water aërated by water weeds, and grass. This species also breeds in the rice fields towards the end of the rains, when the rice plants have attained a certain height. It is not partial to muddy water and is therefore rarely found in newly constructed borrow-pits and muddy tanks, when free of weed and grass.

A. fowleri is almost as common as A. fuliginosus, but its prevalence is more dependent upon season. During the last four months of the year in the western (Wainganga) rice tract, which is much more wooded and better irrigated than the eastern, the proportion of A. fowleri to A. fuliginosus in every catch is as 7 to 2, whereas in the eastern tracts A. fuliginosus is in the majority. It breeds mainly in the rice fields, but the larvæ are also found in tanks and borrow-pits when near rice fields. Upon the gradual drying up of the rice fields the number of this species found greatly diminishes. I have found specimens throughout the cold weather and in the month of May (Pendra 2,000 ft.), and have bred out larvæ in the month of December from the Pachmarhi Lake (3,500 ft.). In the Chhattisgarh plains it is not easy to find specimens once the rice fields have dried.

These two species A. fuliginosus and A. fowleri increase to an enormous extent towards the end of the rains, so long as there is fairly clear water containing vegetation, rice field, tank, or flooded fallow, for breeding; their numbers increase in proportion to its extent, A. fowleri mainly selecting the fields in the more wooded country. Thus on the drying up of the fields its numbers dwindle to small proportions, compared with the persistent tank breeder, A. fuliginosus. In these open plains, covered with rice fields, there is a great increase in the prevalence of malarial fever towards the end of the rains (September and October), but it is a fever which is both non-fatal, as seen by the moderate death-rate, and mild in the sense of being soon over and leaving no after-results in the form of ill-health and splenic enlargement. Thus on a small scale there is a yearly epidemic of malaria of a benign nature, due to sheer force of numbers of anophelines; upon the diminution of the breeding-grounds following upon the cessation of the rains the epidemic dies down. In exceptional years when a very heavy rainfall is accompanied by breaks at favourable intervals, leading to the maximum output of anophelines, the prevalence of fever is excessive and the death-rate becomes raised. There is now a widening opinion that fuliginosus is not the carrier of malaria under ordinary conditions, such as prevail in normal years throughout this rice country.

The great prevalence of this species during the period subsequent to that of the fever outburst, tends to support this view. The localisation and wide prevalence of A. fowleri, in the fever season only, suggests that it is a carrier; although my dissections were negative, my assistant Mr. Goverdhan found zygotes in two specimens caught in the extreme south of the Chanda district during December.

A. culicifacies, although widely distributed, comprised a very small proportion of the catches in the open country. It mainly breeds in streams and irrigation channels, but was on several occasions bred out from tanks and old borrow-pits with grass-grown banks and clear water. Although this species is the principal carrier of malaria in the endemic tracts, its absence from large areas of the open rice tract, more especially those devoid of rivers and streams, exclude it as the cause of the autumnal fever in healthy rice areas.

A. sinensis, like A. fowleri, prefers the more wooded and better irrigated rice plains of the Wainganga Basin. It was never found far from trees, and breeds in weedy tanks, irrigation channels, and rice fields. At the end of November some fields with an over-ripe rice crop, standing in water not far from scrub jungle, were literally swarming with the larvæ of this species. On the other hand, the mosquito catches from the villages rarely contained specimens.

A. rossi formed about 7 per cent. of the total catches, it breeds in rain water puddles, ditches, borrow-pits not far from habitations and is very partial to muddy water.

A. maculipalpis, like A. sinensis, was mainly found in wooded country, and in small numbers only. It was bred out from larvæ found in tanks containing weeds, &c., not far from jungle.

A. barbirostris was occasionally found and then only in the neighbourhood of jungle. The larvæ were found in tanks and in small streams both in Nagpur and in Jubbulpore.

Such are the anophelines of the open rice-cultivated plains, and although they form a fairly lengthy list, they do not appear to contribute to the factors which under the prevailing conditions render a place endemic. Cases of enlarged spleen or severe malaria (remittent, relapsing, &c.) certainly do occur in these healthy areas, but it will nearly always be found, that such are imported cases

from endemic areas, which are situated within a few days' journey of even the most centrally placed villages. There are always a certain number of villagers performing pilgrimages to some mountain shrine, attending marriage ceremonies and visiting their relatives in the endemic area, and the usual subsequent history is an attack of fever with several relapses.

The endemic areas (*i.e.*, with a spleen rate between 10 and 50 per cent.) of the rice country of these Provinces are the following:—

(*a*) the borderland of the open plains, towards the hill ranges, where the jungle has been partly cleared only, leaving patches and strips of forest and scrub between the different village lands;

(*b*) cultivated areas adjacent to isolated blocks of forest, or to irregular groups of hills covered with forest or with long grass;

(*c*) cultivated areas on the plateau of the regular mountain ranges, within a mile or two of jungle, or waste land covered with undergrowth or long grass in continuity with jungle.

The above three types of rice country are endemic even in the absence of irrigation, but a mountain stream or shady nulla containing water the greater part of the year, will usually be found in such situations.

(*d*) cultivated irrigated areas in well wooded country.

A considerable portion of the western rice tract is of this nature, the central portions consist of a wide open plain and are non-endemic, but the other parts are well wooded and contain many fine groves and avenues (the Bhandara district being known as the Lake country). In this area there is a considerable amount of tank irrigation and malaria is moderately endemic, except near the forest when the endemic rate immediately rises.

The following table gives the result of the spleen examination of this endemic area:—

No. of villages.	Total No. of children examined.	No. with enlarged spleen.	No. with no enlargement.	Spleen rate.
251	9,075	2,195	6,880	24·1

The anophelines are all those of the healthy areas, except that A. culicifacies becomes more prominent and A. rossi less so. In addition, A. listoni appears in most of the catches, it was bred out from larvæ found in clear water-irrigation channels lined with weeds. This species was never found far from trees and shade.

The hyper-endemic areas are those in which jungle and hill are found in excess and in close proximity to villages, the greater the extent to which jungle and waste land, covered with long grass or scrub and in continuity with forest, replaces open cultivation, the more malarious an otherwise healthy rice tract becomes.

Thus the borders of the cultivated rice plains at the foot of the mountain ranges, the narrow valleys through which the mountain streams debouch upon the plains, the small isolated patches of cultivation in forest-clearings and the fringe of the plateau, when bordered by jungle, are hyper-endemic, whether irrigation is present or not; in these situations favourable breeding grounds with ample shade exist.

The anophelines most constantly found in these hyper-endemic areas are culicifacies, listoni, theobaldi, maculipalpis, jeyporensis, fuliginosus, and fowleri, with the addition of maculatus and willmori when in the neighbourhood of extensive forest.

A spleen census of this area is shown in the following table:—

No. of villages.	Total No. of children examined.	No. with enlarged spleen.	No. without enlargement.	Spleen rate.
436	8,971	6,327	2,644	70·5

Apparently the two essential factors which determine whether a healthy rice area shall be endemic are—

(1) suitable breeding grounds for anophelines;

(2) the proximity of shade in the form of jungle, long grass, thick vegetation and undergrowth.

The breeding grounds must be such (irrigation channels, streams, weedy pools in the bed of a nulla, &c.), as are selected by such species as A. culicifacies, listoni, theobaldi, jeyporensis, &c. The presence of one condition without the other does not appear sufficient to increase the endemicity.

One constantly finds villages in the open rice plains on the banks of a culicifacies-breeding stream, they lack the *shade* essential for the endemic factor and remain healthy; again one comes across villages with rice fields up to the house doors and plenty of shade, but the essential *breeding grounds* are wanting and malarious spleens are unknown.

(A. stephensi, mainly a "well" breeder and a proved malaria-carrier, has up to now not been found in the rice areas of these provinces, wells moreover are few and far between, tanks forming the main source of the drinking water-supply.)

The association of malaria with rice cultivation under certain conditions only, is reflected in the *vital statistics* of these areas.

Briefly the following results are noticed:—

The birth-rate is high in both healthy and endemic areas.

The monthly distribution of births varies according to the situation, whether in healthy or endemic areas. In a healthy area the births are greatest in number during the autumn months. In an endemic area, on the contrary, the monthly birth-rate is at its maximum during the early part of the year.

The death-rate in hyper-endemic areas shows an average increase of 10 to 15 per mille per annum, over that of healthy rice tracts.

The explanation and statistics leading to these conclusions are mentioned in my articles (which deals with the rice areas only) in the third number of "Paludism."

Malarial parasites in the endemic areas.

The results of the examination of 400 blood films, taken in various parts of this rice area, and classified according to the degree of splenic enlargement, are given in the following table:—

Malarial parasite.	Spleen palpable.	Spleen 2 to 3 fingers.	Spleen hand's-breadth.	Spleen to navel.	No enlargement.	Total.	Per cent.
Malig. T. ..	39	45	3	2	18	107	27
Benign T. ..	6	12	2	2	3	25	6
Quartan ..	21	24	25	9	6	85	21
Mixed ..	4	3	7	..	2	16	4
Negative ..	42	44	41	12	28	167	42
TOTAL ..	112	128	78	25	57	400	..

This clearly shows the close association of the Quartan parasite with the higher degrees of enlargement of spleen, in endemic places; it also shows that the moderately enlarged spleens give a much higher percentage of positive results than the greatly enlarged spleens.

Conclusions.

This survey shows that rice cultivation as carried out in the Central Provinces is harmful under certain conditions only, *viz.*, when accompanied by irrigation in thickly wooded areas, or in the neighbourhood of jungle, or of waste land covered by long grass or scrub, near jungle; in other words, *irrigation* and *shade.*

The great increase in the population, in the absence of marked immigration, of the open sparsely wooded rice plains during the last intercensal period, *e.g.*, increase of 32 per cent. in the State of Nandgaon, and of 54 per cent. in the State of Sakti, in comparison with the backward condition of some of the jungly zemindari areas, shows that the more or less complete clearance of anything in the shape of jungle in these plains must be of benefit.

During the last 40 years the population of the Chhattisgarh division alone shows an increase of 81 per cent. in the net variation in relation to density.

The State has now in hand large irrigation projects, and efforts are being made to colonise certain areas commanded by tanks. These schemes will defeat their own ends if they tend to raise the malarial endemicity of places along the distribution channels. There will be no danger of this in the widely open plains, but as I have shown, the Wainganga area is in places thickly wooded, and contains many backward tracts near to jungle, as Baihar, &c. Irrigation in these places without precautionary anti-endemic measures, is tempting Providence. It would supply the most important factor in producing endemic malaria.

It is of the utmost importance therefore that the distribution channels should be as open as possible, and anything in the form of jungle, long grass, dense vegetation and undergrowth thoroughly cleared from their neighbourhood.

MALARIA IN WYNAAD.

BY

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THE Wynaad is a hilly plateau, to the south-west of the Nilgiri Hills, 50 miles long by 20 broad and lying at an elevation of 3,000 feet.

It is and has been a place of considerable economic importance : once the finest coffee growing ground in India till the appearance of the fungus disease about the year 1870, it has experienced booms of cinchona, pepper, and tea planting, the latter of which is at present extensively carried on in the south and south-east parts of the district.

It has long been regarded as one of the worst fever areas in Southern India, and of recent years certain tea companies have made a serious effort to grapple with the malaria problem and have sought financial aid from Government for an anti-malarial scheme.

It was with a view to ascertaining the conditions present, and the feasibility of their being dealt with by anti-mosquito measures that an investigation was carried out during May and June of this year.

A. GENERAL CONDITIONS.

The Wynaad consists for the most part of a succession of low rounded laterite hills covered with grass or jungle, or planted with tea. Between and among these hills runs a net-work of swamp, mostly overgrown with tall rank jungle and gradually emerging in definite streams. Besides these streams, there are numerous hill burns, turbulent in their upper reaches, smooth flowing and well stocked with fish (Haplochilus, Danio, Barilius) in their course along the valley beds. These swamps and streams form the crux of the malaria problem in Wynaad.

The rainfall is heavy and constant, averaging over 100 inches annually ; it is brought by both monsoons, but chiefly by the south-west.

In spite of its feverish reputation the climate is not unhealthy. The hot weather maximum temperature seldom exceeds 85° ; in the cold weather the Wynaad is the Sanitorium of Malabar.

The " fever " season according to local report is from March to May (*i.e.*, in the hot weather months) : it ceases with the onset of the south-west monsoon in June and may be succeeded by a small burst of " fever " in September. The accuracy of this statement is borne out by the total mortality curves of the Wynaad taluq and the larger villages under survey, and also by the conditions met with at the time of investigation. The prevalence of the fever previous to the monsoon is noteworthy and has led some observers to doubt its malarial nature.

In south-east Wynaad where the ground is flatter and more open, fever is considered to have diminished to an appreciable extent within the last 40 or 50 years ; elsewhere it has maintained its hold, now and again bursting out in epidemic form and causing panics and serious labour difficulties on the estates.

The population is scanty and averages only 100 to the square mile. It diminished steadily from 1871-1901, but has increased in the last ten years.

It consists of two main classes :—

(1) aboriginal jungle tribes—permanently resident in Wynaad and living in scattered groups of huts in the jungle ;

(2) village traders, hawkers, etc., and families :—resident in the villages on the main roads and frequently changing.

There is also a large moving population consisting of coolies employed on the various estates amounting roughly to 10,000 odd, and coming from Mysore, Coimbatore, Malabar, etc. These enter Wynaad chiefly in May and June, work on the estates through the monsoon and cold weather and go down to their homes in February, when the slack season commences. A small number remain on the estates, but the majority are away from Wynaad for about three months in the year.

B. Malarial Conditions.

1. *Mosquitoes.*

Adult anophelines were very hard to get. This, probably, was partly due to the nature of the house interiors (dark, mud walls, and high roofs), which rendered capture difficult. But some reduction of adults appeared to have taken place in May, as they were seldom seen or complained of in bungalows where a few weeks previously they had been a pest.

The adult anophelines taken were :—

	No. taken.	No. dissected.	No. infected.
listoni	33	30	2
willmori	3	3	—
jeyporensis	1	1	—
culicifacies	1	1	—
rossi	1	1	—

Anopheline larvæ on the contrary swarmed, and from these the following eleven species were bred out :—

1. N. maculipalpis.
2. N. jamesi.
3. N. karwari.
4. N. maculatus.
5. N. willmori.
6. M. listoni.
7. P. jeyporensis.
8. Nsm. rossi.
9. My. barbirostris.
10. Ns. aitkeni.
11. Nm. elegans.

Maculipalpis and willmori were the most abundant and were found breeding chiefly in swamps, in surface drains in swamps, and in swamp streams.

Listoni was also common. Its chief breeding places were swamps and hill-streams.

Jeyporensis was found in only two places, both weedy pools, one of them a spring in an open field.

Elegans and aitkeni were also scarce : the former was taken in a shady surface well in the jungle, the latter in streams.

Among Culicinæ, Stegomyia scutellaris and Tæniorhynchus were most in evidence. Culex mimeticus was frequently found breeding in swamps.

Hulecoetiomyia, a mosquito closely resembling Stegomyia fasciata in markings, habits and type of breeding place, was also occasionally taken.

Spleen and Parasite Rates.

(1) *Villages.*

With the exception of a few in south-east Wynaad, these all showed a fairly high degree of infection, especially those inhabited by jungle tribes. This is best seen from the following figures :—

	Spleen Index.			Parasite Index.		
	No. of children.	No. with enlarged spleen.	Percentage.	No. of films.	No. infected.	Percentage.
Jungle Tribe Villages.						
1. Trikaipetta	18	17	94·2	18	10	55·5
2. Kotapade	45	39	86·7	37	19	51·4
3. Nemini	89	76	85·4	20	7	35
Villages on main roads.						
4. Meppadi	78	35	44·9	73	21	28·8
5. Kalpetta	61	49	82	55	18	32·7
6. Vaitri	94	45	47·9	72	22	30·5
7. Sultan's Battery ..	43	30	69·8	20	5	25
Villages in south-east Wynaad.						
8. Gudalur	50	42	16	—	—	—
9. Devashola	19	5	26·3	—	—	—
10. Devala	15	12	80	—	—	—
11. Pundalur	23	13	56·4	19	6	31·6

Of these villages, Nos. 1, 2 and 4 alone were examined for carriers and breeding places. Infected listoni were found in Nos. 1 and 2. All three were in the close vicinity of streams and swamps, breeding listoni and maculipalpis.

As regards the type of parasite present, 51% were simple tertian, 38% quartan, and 11% malignant tertian. 59% contained gametes.

(2) *Estates.*

Here also malaria is rife. 71 *estate children*, of whom 23 were Paniars (aboriginal tribes), gave a spleen rate of 70%.

	No. of children.	No. with enlarged spleen.	Percentage.
Paniars	23	18	78·3
Others	48	32	66

As regards adult coolies, 54 such who had been at work throughout the hot weather (fever season) on an intensely malarious estate gave a spleen rate of 56%.

231 coolies examined within seven days of their arrival in Wynaad gave a spleen rate of 57%. All these had been in Wynaad a few months previously.

The difficulty of obtaining new (*i.e.*, for the first time) arrivals scarcely justifies an opinion being given as to whether the malaria that prevails on these estates is chiefly contracted locally or in the coolie recruiting area outside. There is no doubt that some of the coolies are recruited from malarious areas in Mysore and Malabar; but the high degree of infection in children and immunity in adults among the jungle tribes who never leave the Wynaad, and the history of repeated malaria attacks among the otherwise healthy European staff on the estates, favour the conclusion that the real source of the trouble is local.

A SHORT NOTE ON THE USE OF LARVICIDAL FISH IN COMBATING MALARIA FEVER.

BY

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Corporation of Madras.

CERTAIN species of surface-eating fish have been recognised as destroyers of mosquito larvæ in tanks, wells, and other collections of fresh water. From an economical point of view, therefore, this ally in anti-malarial measures would be of inestimable value to us if we could have all our permanent collections of water stocked with them. The remarkable immunity of Barbados from malaria was pointed out to be due to the presence of certain species of fish, " the millions ", abounding in the streams and pools of the island.

In the north of Madras (1, 2 and 3 divisions) there was a severe epidemic of malaria with its highest death-roll during November and December 1912, and the first quarter of 1913. Within the area of 5·31 square miles of more or less porous sandy soil, there were no less than 513 tanks and 2,627 wells besides innumerable transient pools and cesspits. The population in the area is 76,073, showing that the density is not high. The tanks which were mostly used for irrigation of cocoanut plantations and garden lands are aggregated towards the north-west (2nd and 3rd divisions) of this area; the wells are grouped more to the south and south-east. It is noteworthy that the epidemic raged mostly in the tank zone. Most of these tanks were breeding places for anopheles mosquitoes as will be mentioned presently.

The larvicidal fish usually met within Madras City may be here mentioned.

(1) Haplochilus in tanks generally.

		Tamil Name.
Species.	H. panchax H. melastigma H. lineolatus	*Velichai Kendai.*
(2) Chela—In tanks generally.		*Buddadarika (Telugu).*
(3) Rasbora daniconius (common minnow).		*Parava Kendai.*
(4) Therapon Jarbua. In brackish water.		*Keeli.*

Haplochilus predominates and has been found to be a very efficient larvicide. These fish are most voracious, and seem to be continually feeding, and are peculiarly suited as surface-feeders, as they are small and can accommodate themselves to the shallows in the shelving margins of a tank. Chela and Rasbora are not bad larvicides. Therapon Jarbua is a very efficient destroyer of larvæ, but they are not so widely distributed.

On hearing from Mr. H. C. Wilson, Piscicultural Expert to the Government of Madras, about the varieties of larvicidal fish to be stocked in tanks, and wells, 53 tanks and 12 wells were stocked with fish early in February, in the 3rd division of the city. In the 2nd division 41 tanks and 34 wells were supplied with fish by the end of October.

It was at first puzzling to find that larvicidal fish (chiefly the genus Haplochilus) were visible in most of these tanks in great numbers, and yet anopheles larvæ did not appear in any way to diminish. It became evident that fish could make no headway against the larvæ.

The history of the Tamil Mission Orphanage in the 3rd division to the west of Dhobipet and the experience acquired is not without interest. This Orphanage is situated in a large cocoanut plantation in the vicinity of which are several tanks. The buildings are surrounded by a broad deep moat and are approached at one point by a masonry bridge. In February when first inspected the water was found " carpeted " with a dense mass of fresh water algæ containing Haplochilus and larvæ in abundance. The Principal complained of the myriads of mosquitoes infesting the premises after night. On any morning in February anopheles could be captured by the dozen in the dormitories and even in the shady parts of the dense

jungle around. The larvæ when examined were found to be those of anopheles *ludlowi, fuliginosus, jamsei, barbarostris* and could be recovered in profusion from any part of the moat.

With the intelligent co-operation of the Principal the weeds were removed, the margins trimmed of all vegetation and shallows, hollows, and footprints were cut away, leaving a steep earth gird in touch with the water. These conditions have been maintained ever since by the older boys in the Orphanage. It may be mentioned that petrolizing was also resorted to, it having been found that the fish were not in any way interfered with. Quinine treatment was also kept up side by side with mosquito reduction operations.

Before these operations were undertaken nearly all the inmates (numbering about 80) were prostrated with malaria fever. By the end of March it was reported that the number of mosquitoes had greatly diminished and there was a marked improvement in the health of the inmates and larvæ were more difficult to find. The results were progressively maintained, for by June 1913, there was not a case of active fever and larvæ could not be traced. It may be noted that there has been no relapse to former conditions since.

It may be mentioned that the splenic index of Dhobipet, which embraces the Orphanage, and was the storm centre of the malaria epidemic, showed 88·5 per cent. in February. In August the percentage was reduced to 55·1 per cent.

In dealing with perennial tanks similar methods have been extended throughout the tank area at the extreme north of Madras.

The following table of the mosquito surveys of tanks and wells is given. The difference in the total number of tanks and wells seen in the two surveys is due to the exclusion of some tanks and wells from the second survey owing to rain, and the obliteration of tanks and wells in submerged parts :—

		Tank.			Wells.		
		Total number examined.	With Anopheles.	Without Anopheles.	Total number examined.	With Anopheles.	Without Anopheles.
1st Survey completed in June	Actuals ...	513	166	347	2,627	107	2,520
	Percentage	...	32·4	67·6	...	4·1	95·9
2nd Survey completed in October.	Actuals ..	353	86	267	2,522	51	2,471
	Percentage ...	.	24·4	75·6	...	2·0	98·0

It must be understood that it is not urged that stocking tanks with larvicidal fish can ever replace the more valuable and lasting measure of reclamation, but it is worthy of consideration whenever permanent works are barred for financial reasons. The latter circumstance applies to Madras especially in dealing with the tank zone in the north of the city already referred to, where valuable cocoanut plantations abound, dependent for irrigation on tanks, and wells only. Apart from the actual value of the land which, to acquire, would be prohibitive, the cost of an expensive reclamation added to this puts the proposal beyond municipal resources.

There is yet much to be done in investigating the habits of these larvicidal fish, and further study is required to be directed towards the chemical treatment of tanks to prevent the growth of algæ and other aquatic weeds, and without at the same time destroying the fish. If the latter can be attained the human factor can be eliminated in tank cleansing, and a maximum of success from the larvicidal species of fish may then be expected.

A SUGGESTION REGARDING ANTI-MALARIAL SANITATION SPECIALLY ADAPTED FOR BENGAL.

BY

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THE investigations of Christophers in the Punjab and Robertson and Graham in the United Provinces have shown that in these parts of India many of the large towns exhibit a fairly high incidence of malarial infection throughout their whole area. But this incidence is not quite uniform, some localities, usually those towards the centre of the town possessing lower spleen and parasite indices than others. In Bengal, however, this condition is still more emphasized, and even small towns in that province, situated in districts known to be intensely malarious, usually possess an area in their centre in which malaria appears to be almost non-existent or present in only small amount.

Observations point to this being a very general condition, even in towns which at first sight appear to possess ample breeding places suitable for *N. fuliginosus* and other anopheles to breed. It has been noted in Krishnagar, Burdwan, Baruipur, Faridpur, Ranaghat and Dinajpur. It does not appear always to bear a definite relation to the presence of a surface drainage system, for it has been observed in towns like Ranaghat which do not as yet possess one ; neither is it associated with control of the water-supply, for towns like Dinajpur in which the supply is almost entirely from private wells and tanks, there being about 2,000 of the former and 80 of the latter, still exhibit the same phenomenon.

As the areas of comparative freedom from malaria usually correspond to the most thickly populated business portions of the town, where shops and masonry buildings are crowded together, the condition is possibly bound up largely with the fact that many of the collections of water which might otherwise be dangerous sources of anopheles have been so largely contaminated with sullage as to be comparatively unsuitable for them. But there is another factor which appears to be partly responsible for the condition. Side by side, with a possibly diminished number of anopheles in the area, there is always the presence of a very dense population there, so that malarial infection exists as it were in a very diluted condition.

In a paper on " Problems of Malaria in Bengal " read before the last Malaria Conference, attention was called to the fact that, as an increase in the number of anopheles among a human population of fixed number will lead to a proportionate increase in the incidence of malaria, so a decrease of human population in the presence of a fixed number of anopheles may be expected to result in an increased incidence of infection. And the converse should hold good also. So that if in any area we can increase the human population, at the same time preventing any increase in the number of anopheles existing there, we may expect to find a gradual reduction in the static malaria of the community automatically to follow. It may be stated that, on theoretical grounds there are reasons for believing that, in the case of a community with a static malaria rate of 45%, a doubling of the human population on the same site, without any corresponding increase of anopheles, would tend automatically to cause the infection rate to fall below 1%. Similarly a 50% increase in a human population whose static malaria rate was 30% would tend to reduce infections below 1% ; and a 20% increase in a population with a static malaria rate of 20% would also tend to bring about a fall in the infection rate to below 1%.

This suggests an anti-malarial measure applicable to certain places where the population is spread over a very wide area, more especially to smaller towns like those in Bengal, namely, the encouragement of municipalities to take action, with due precautions to prevent overcrowding, to bring about a greater concentration of the population upon the town site. Anyone familiar with conditions in Bengal is aware of the fact that many of the municipalities there often resemble a collection of scattered hamlets grouped round a central bazaar, and intermingled with large areas of waste land, useless tanks, garden plots overgrown with jungle, large houses in a state of ruin surrounded by extensive ground in a condition of neglect, together with patches of jungle and cultivation. If these uninhabited areas could be gradually

eliminated, the sites improved by the erection of dwelling-houses, and people encouraged to reside there, the result would be a gradual diminution of malaria in the neighbourhood. To bring about this change, municipalities in Bengal, where such conditions exist, should be encouraged to use the powers they possess under the Bengal Municipal Act for dealing with jungle, undrained areas, ruined houses, and useless tanks. It may also be found possible to frame other measures which will place in the hands of Municipal Commissioners further powers enabling them to encourage a reasonable concentration of their scattered population.

A consideration of these points suggests another measure applicable to rural districts in Bengal, namely, the establishment of model townships. This is not a new suggestion. The Bengal Drainage Committee stated in their report in 1907 (page 23, paragraph 26) :—

"That the improvement of village sites is the primary essential in the prevention of malaria we consider to be undoubted, and the practical demonstration of this fact by action taken in a selected area, might have a valuable effect upon public opinion. It would be worth the while of Government to afford such an object lesson."

But although the measure may be thought more ideal than practical at the present time, there are reasons for believing that it is along these lines that sanitary reform in the rural districts of Bengal will sooner or later advance. The most pressing needs of rural communities in Bengal are pure water-supplies, simple conservancy, and village roads, as well as a reduction of malaria. And the greatest obstacle to such reform, whether related to prevention of malaria, the provision of a pure water-supply or the adoption of systems of conservancy, lies in the scattered nature of the population, which makes the cost of every scheme absolutely prohibitive. It is not difficult to provide a population of from 6,000 to 10,000 persons living in close proximity to one another, with a scheme for water-supply, or a conservancy at a reasonable cost, but it is an impossible task to carry out such schemes among the same number of people scattered over the country in a score of villages. In very many parts of Bengal 6,000 to 10,000 people are to be found living in scattered hamlets, within a circle of one mile radius. Their greater concentration would cause no real danger ; and this suggested concentration appears to offer a partial solution of the problem of malaria reduction, as well as a simplification of other sanitary improvements.

The most feasible method of carrying out the establishment of model townships would appear to be as follows :—

Sites should be chosen in fairly densely populated rural areas in which the character of the population appears suitable. Preferably these sites should be in places already possessing institutions for the public service, such as schools, post offices, dispensaries and bazaars. After being surveyed the areas should be acquired and the land plotted out on the lines of a planning scheme, adapted, as far as possible, to existing institutions. Roads should be provided, simple drains cut and arrangements made for a public water-supply from reserved tanks or by some other system. Thereafter substantial encouragement should be given to residents in the neighbourhood to secure plots for the erection of dwelling-houses, shops, etc., due precautions being taken against indiscriminate excavation, the multiplication of private wells or tanks, the growth of jungle and other similar abuses.

By such a policy it may be possible to gradually increase the number of small sanitated townships throughout a district, whose presence will serve as an educative and civilizing influence upon the neighbourhood, teaching it the advantages of co-operation for sanitary reform and instilling the leaven of civic responsibility among the population. The essence of these suggestions is civilization. And civilization pre-supposes education in its broadest sense. Therefore it is essential that education, especially in regard to the requirement of civic life, which means also in regard to sanitation generally, should be pressed forward by every possible means. And it is this function of civic education which the State is peculiarly well fitted to undertake, not so much by the carrying out of public measures, as by stimulating and encouraging private persons and public bodies to carry them out. For as we do not teach a school boy mathematics by solving problems for him but by setting him tasks just within his power and seeing that he solves them himself, so we can only teach the members of a community the elements of sanitation by encouraging them to sanitate themselves.

ON THE VITALITY OF THE CHOLERA VIBRIO OUTSIDE THE HUMAN BODY.

BY

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AT the Sanitary Conference at Madras in 1912 I dealt (1, 2, 3, 4) with the question of the life of the cholera vibrio in the human host; in this communication I shall consider the question of the vitality of the organism after it escapes from man.

In 1907, I made observations (5) on the life of the B. typhosus outside the human host in India. In my investigations I used, for the purpose of testing the duration of life of the B. typhosus, in addition to laboratory cultures, uncultivated strains of the organism, that is to say, the bacillus as it occurred in the fæces and urine of "carriers" or patients, and which had never been grown on artificial media. Up to that time the observations on the vitality of the organism had been made chiefly with strains cultivated on artificial media for very varying periods. I give below two tables from my previous research on enteric fever

TABLE I.

The following table shows the result of allowing urine from a case of enteric fever containing many bacilli to stand at room temperature, 80°F. protected from the sun (6) :—

No. of expt.	Name, number, regiment of patient.	Date of passing sample of urine.	Date of examination of urine.	Number of colonies of bacillus typhosus.
I	S. No. 8089 .. Oxford L. Infantry.	13th June 1907 ..	13th June 1907 ..	36,000,000 per c.c.
			16th June 1907 .. (72 hrs.)	Sterile.
II	Ditto ..	14th June 1907 ..	14th June 1907 ..	30,000,000 per c.c.
			16th June 1907 .. (72 hrs.)	Sterile.
III	S. No. 8089 .. Oxford L. Infantry.	15th June 1907 ..	15th June 1907 ..	62,000,000 per c.c.
			16th June 1907 .. (24 hrs.)	1,000,000 „
			17th June 1907 .. (48 hrs.)	100,000 „
			18th June 1907 .. (72 hrs.)	Sterile.
IV	Ditto ..	16th June 1907 ..	16th June 1907 ..	60,000,000 per c.c.
			17th June 1907 .. (24 hrs.)	29,060 „
			18th June 1907 .. (48 hrs.)	Sterile.

TABLE II.

The following table shows the results of allowing fæces (of a 'carrier') containing many bacilli to stand at room temperature, 85°F. protected from the sun (7) :—

Name, number, regiment of patient.	Date of passing sample of fæces.	Date of examination of fæces.	Bacillus typhosus in fæces.
Sepoy G. Rao, Maharatta Light Infantry, Poona.	19th September 1907 ..	19th September ..	+ + +
		20th „ ..	+ +
		21st „ ..	+ +
		23rd „ ..	+ +
		24th „ ..	−
		26th „ ..	−
		27th „ ..	−
			(Large number of B. coli.)

As cases of cholera occur all the year round in Calcutta I am able both to make observations in the different seasons and to use for the research uncultivated strains

of the cholera vibrio. The experiments, commenced about a year ago, are still in progress, but meantime some points of interest and importance have emerged from them which I propose to bring forward in this paper.

Methods.

The rice water stool is examined very shortly after being passed and the presence of the cholera vibrio determined. The stool is placed in a sterile flask which is protected from the sun by placing in a cupboard. It is kept at room temperature and evaporation is prevented. Samples are taken daily from the stool and insemi nated in flasks of peptone water which are placed in the incubator at 37°C. and subcultures were made after 6-12 hours, and in the usual way (1, 2, 3, 4) the presence or absence of the cholera vibrio was determined. When the result of the examination showed the absence of the cholera vibrio from the stool for several days, the whole of the remainder of the stool was inseminated in peptone water in order to confirm the absence of the cholera vibrio. In some cases the actual number of cholera vibrios in the rice water stool is being counted daily. For this purpose a fixed quantity of the stool is plated on agar and the number of colonies counted, and stated as so many per c. c. of rice-water stool. Also fixed quantities of rice-water stool, 1 c.c., 5 c.c., etc., are placed in peptone water and incubated and the presence or absence of cholera vibrios is determined by subculturing on Dieudonné blood agar and ordinary agar and testing in the usual manner. The cholera vibrio is stated to be present or absent in 1 c.c., 5 c.c., etc., of rice-water stool. In the early stages of the examination of the stool, when the cholera vibrios are numerous and the other organisms few, the number of the former in the rice-water stool can be determined exactly by direct plating, but in the final stages when the conditions are reversed, and the above technique no longer possible, then the peptone water combined with selective media shows the quantities of rice-water stool in which the cholera vibrio is present or absent. We are thus able to follow from day to day the mortality amongst cholera vibrios populating any given quantity of a rice-water stool.

Up to the present time (November 1913) I have investigated a total of 94 stools: samples were examined in Calcutta in each month from December 1912 to October 1913.

By the above procedure I am able to study the vitality of the cholera vibrio under natural conditions. Thus the strains used, after leaving the human host, are not cultivated at all on artificial media, but are allowed to remain in the same medium—the rice-water stool. The organisms were protected against the action of drying which is known to be a particularly unfavourable condition for the cholera vibrio, and also against the effects of the sun. There is a tendency for cultivated strains to maintain their vitality longer than uncultivated. Houston(9) has shown this in regard to the vitality of B. typhosus in Thames water under conditions of storage.

All these observations are being made at Calcutta. As I am using a large number of different uncultivated strains of cholera vibrios in their natural medium for the purpose of the research, the results are, consequently, more comprehensive and reliable than would have been the case if a few old laboratory strains in an artificial medium had been employed.

Table III.

The following table shows the registered number of the case, the date of passing the stool, the date of examination of the stool, and the presence or absence of the cholera vibrio :—

Serial No.	Number of case in the Register.	Date of passing stools.	Dates of examination of stools.	Presence, or absence, of comma bacillus in the stool.
	I. 8	2nd December 1912 ..	2nd December 1912 ..	+
			6th " " ..	+
			7th " " ..	−
			9th " " ..	−
			10th " " ..	−
			11th " " ..	−
2	I. 9	3rd December 1912 ..	3rd December 1912 ..	+
			6th " " ..	+
			7th " " ..	−
			9th " " ..	−
			10th " " ..	−
			11th " " ..	−

TABLE III.—(*Contd.*)

Serial No.	Number of case in the Register.	Date of passing stools.	Dates of examination of stool.	Presence, or absence, of comma bacillus in the stool.
3	I. 10	5th December 1912 ..	5th December 1912 ..	+
			6th " " ..	+
			7th " " ..	+
			9th " " ..	+
			10th " " ..	+
			11th " " ..	+
			12th " " ..	−
			13th " " ..	−
			14th " " ..	−
			16th " " ..	−
4	I. 11	5th December 1912 ..	5th December 1912 ..	+
			6th " " ..	+
			7th " " ..	−
			9th " " ..	−
			10th " " ..	−
			11th " " ..	−
5	I. 12	11th December 1912 .	11th December 1912 ..	+
			12th " " ..	+
			13th " " ..	−
			14th " " ..	−
			16th " " ..	−
			17th " " .	−
6	I. 13	11th December 1912 ..	11th December 1912 .	+
			12th " " .	+
			13th " " ..	−
			14th " " ..	−
			16th " " ..	−
			17th " " ..	−
7	I. 14	16th December 1912 ..	16th December 1912 ..	+
			17th " " ..	−
			18th " " ..	−
			19th " " ..	−
			20th " " ..	−
8	I. 15	18th December 1912 ..	18th December 1912 ..	+
			19th " " ..	+
			20th " " ..	+
			21st " " ..	+
			23rd " " ..	+
			24th " " ..	+
			25th " " ..	+
			26th " " ..	+
			27th " " ..	+
			30th " " ..	−
			31st " " ..	−
			1st January 1913 ..	−
9	I. 16	18th December 1912 ..	18th December 1912 ..	+
			19th " " ..	+
			20th " " ..	−
			21st " " ..	−
			23rd " " ..	−
			24th " " ..	−
			25th " " ..	−
			26th " " ..	−
			30th " " ..	−
10	I. 20	4th January 1913 ..	4th January 1913 ..	+
			6th " " ..	+
			7th " " ..	+
			8th " " ..	+
			9th " " ..	+
			10th " " ..	+
			11th " " ..	+
			13th " " ..	+
			14th " " ..	+
			15th " " ..	+
			16th " " ..	−
			17th " " ..	−
			18th " " ..	−
			20th " " ..	−
11	I. 24	16th January 1913 ..	16th January 1913 ..	+
			17th " " ..	−
			18th " " ..	−
			20th " " ..	−
			21st " " ..	−
12	I. 25	21st January 1913 ..	21st January 1913 ..	+
			22nd " " ..	+
			23rd " " ..	+
			24th " " ..	+
			25th " " ..	+
			27th " " ..	+
			28th " " ..	−
			29th " " ..	−
			30th " " ..	−
			31st " " ..	−

TABLE III.—(*Contd.*)

Serial No.	Number of case in the Register.	Date of passing stools.	Dates of examination of stool.	Presence, or absence, of comma bacillus in the stool.
13	I. 26	22nd January 1913 ..	22nd January 1913 ..	+
			23rd " " ..	+
			24th " " ..	+
			25th " " ..	+
			27th " " ..	+
			28th " " ..	+
			29th " " ..	−
			30th " " ..	−
			31st " " ..	−
14	I. 27	26th January 1913 ..	26th January 1913 ..	+
			27th " " ..	+
			28th " " ..	+
			29th " " ..	+
			30th " " ..	+
			31st " " ..	+
			1st February " ..	+
			3rd " " ..	+
			4th " " ..	+
			5th " " ..	+
			6th " " ..	+
			7th " " ..	−
			8th " " ..	−
			10th " " ..	−
15	I. 28	26th January 1913 ..	26th January 1913 ..	+
			27th " " ..	−
			28th " " ..	−
			29th " " ..	−
			30th " " ..	−
16	I. 29	6th February 1913 ..	6th February 1913 ..	+
			7th " " ..	+
			8th " " ..	+
			10th " " ..	−
			11th " " ..	−
			12th " " ..	−
17	I. 31	8th February 1913 ..	8th February 1913 ..	−
			10th " " ..	+
			11th " " ..	+
			12th " " ..	+
			13th " " ..	+
			14th " " ..	+
			15th " " ..	−
			17th " " ..	−
			18th " " ..	−
			19th " " ..	−
18	I. 32	8th February 1913 ..	8th February 1913 ..	+
			10th " " ..	+
			11th " " ..	+
			12th " " ..	+
			13th " " ..	+
			14th " " ..	+
			15th " " ..	−
			17th " " ..	−
			18th " " ..	−
			19th " " ..	−
19	I. 34	10th February 1913 ..	10th February 1913 ..	+
			11th " " ..	+
			12th " "	+
			13th " " ..	+
			14th " " ..	+
			15th " " ..	+
			17th " " ..	−
			18th " " ..	−
			19th " " ..	−
20	I. 35	11th February 1913 ..	11th February 1913 ..	+
			12th " " ..	+
			13th " " ..	+
			14th " " ..	+
			15th " " ..	+
			17th " " ..	+
			18th " " ..	+
			19th " " ..	+
			20th " " ..	
			22nd " " ..	
			23rd " " ..	
21	I. 36	12th February 1913 ..	12th February 1913 ..	+
			13th " " ..	+
			14th " " ..	+
			15th " " ..	+
			17th " " ..	+
			18th " " ..	+
			19th " " ..	+
			20th " " ..	+
			22nd " " ..	−
			23rd " " ..	−
			24th " " ..	−

TABLE III.—(*Contd.*)

Serial No.	Number of case in the Register.	Date of passing stools.	Dates of examination of stools.	Presence, or absence, of comma bacillus in the stool.
22	I. 38	14th February 1913 ..	14th February 1913 ..	+
			15th " " ..	+
			17th " " ..	+
			18th " " ..	−
			19th " " ..	−
			20th " " ..	−
			22nd " " ..	−
23	I. 39	15th February 1913 ..	15th February 1913 ..	+
			17th " " ..	+
			18th " " ..	+
			19th " " ..	+
			20th " " ..	+
			22nd " " ..	−
			23rd " " ..	−
			24th " " ..	−
24	I. 40	17th February 1913 ..	17th February 1913 ..	+
			18th " " ..	+
			19th " " ..	+
			20th " " ..	+
			22nd " " ..	−
			23rd " " ..	−
			24th " " ..	−
25	I. 41	17th February 1913 ..	17th February 1913 ..	+
			18th " " ..	+
			19th " " ..	+
			20th " " ..	+
			22nd " " ..	+
			23rd " " ..	+
			24th " " ..	+
			25th " " ..	−
			26th " " ..	−
			27th " " ..	−
26	I. 43	18th February 1913 ..	18th February 1913 ..	+
			19th " " ..	+
			20th " " ..	+
			22nd " " ..	+
			23rd " " ..	+
			24th " " ..	+
			25th " " ..	+
			26th " " ..	+
			27th " " ..	−
			28th " " ..	−
			1st March " ..	−
			3rd " " ..	−
27	I. 45	22nd February 1913 ..	22nd February 1913 ..	+
			23rd " " ..	+
			24th " " ..	+
			25th " " ..	+
			26th " " ..	+
			27th " " ..	+
			28th " " ..	+
			1st March " ..	+
			3rd " " ..	+
			4th " " ..	−
			5th " " ..	−
			6th " " ..	−
			7th " " ..	−
28	I. 46	24th February 1913 ..	24th February 1913 ..	+
			27th " " ..	+
			28th " " ..	+
			1st March " ..	+
			3rd " " ..	+
			4th " " ..	+
			5th " " ..	+
			6th " " ..	+
			7th " " ..	+
			8th " " ..	+
			9th " " ..	+
			10th " " ..	+
			11th " " ..	+
			12th " " ..	+
			13th " " ..	−
			14th " " ..	−
			15th " " ..	−

TABLE III.—(*Contd.*)

Serial No.	Number of case in the Register.	Date of passing stools.	Dates of examination of stool.	Presence, or absence, of comma bacillus in the stool.
29	I. 47	1st March 1913 ..	1st March 1913 ..	+
			3rd " " ..	+
			4th " " ..	+
			5th " " ..	+
			6th " " ..	+
			7th " " ..	+
			8th " " ..	+
			9th " " ..	+
			10th " " ..	+
			11th " " ..	−
			12th " " ..	−
			14th " " ..	−
			15th " " ..	−
30	I. 48	1st March 1913 ..	1st March 1913 ..	+
			3rd " " ..	+
			4th " " ..	+
			5th " " ..	+
			6th " " ..	+
			7th " " ..	+
			8th " " ..	+
			9th " " ..	+
			10th " " ..	+
			11th " " ..	+
			12th " " ..	+
			13th " " ..	+
			14th " " ..	−
			15th " " ..	−
31	I. 49	6th March 1913 ..	6th March 1913 ..	+
			7th " " ..	+
			8th " " ..	+
			10th " " ..	+
			11th " " ..	+
			12th " " ..	−
			13th " " ..	−
			14th " " ..	−
			15th " " ..	−
32	I. 50	10th March 1913 ..	10th March 1913 ..	+
			11th " " ..	+
			12th " " ..	+
			13th " " ..	+
			14th " " ..	+
			15th " " ..	+
			17th " " ..	+
			18th " " ..	+
			19th " " ..	+
			21st " " ..	−
			22nd " " ..	−
			23rd " " ..	−
33	I. 51	13th March 1913 ..	13th March 1913 ..	+
			14th " " ..	+
			15th " " ..	+
			17th " " ..	+
			18th " " ..	+
			19th " " ..	+
			21st " " ..	−
			22nd " " ..	−
			23rd " " ..	−
34	I. 52	14th March 1913 ..	14th March 1913 ..	+
			15th " " ..	+
			17th " " ..	+
			18th " " ..	+
			19th " " ..	+
			21st " " ..	−
			22nd " " ..	−
35	I. 55	17th March 1913 ..	17th March 1913 ..	+
			18th " " ..	+
			19th " " ..	+
			21st " " ..	+
			22nd " " ..	+
			24th " " ..	−
			25th " " ..	−
			26th " " ..	−
36	I. 57	20th March 1913 ..	20th March 1913 ..	+
			21st " " ..	−
			22nd " " ..	−
			24th " " ..	−
			25th " " ..	−

TABLE III.—(*Contd.*)

Serial No.	Number of case in the Register.	Date of passing stools.	Dates of examination of stools.	Presence, or absence, of comma bacillus in the stool.
37	I. 58	22nd March 1913 ..	22nd March 1913 ..	+
			24th " " ..	+
			25th " " ..	+
			26th " " ..	+
			27th " " ..	
			28th " " ..	−
			29th " " ..	−
38	I. 59	21st March 1913 ..	21st March 1913 ..	+
			22nd " " ..	+
			24th " " ..	+
			25th " " ..	+
			26th " " ..	+
			27th " " ..	+
			28th " " ..	+
			29th " " ..	−
			31st " " ..	−
39	I. 62	24th March 1913 ..	24th March 1913 ..	+
			25th " " ..	+
			26th " " ..	+
			27th " " ..	+
			28th " " ..	−
			29th " " ..	−
			31st " " ..	−
40	I. 63	24th March 1913 ..	24th March 1913 ..	−
			25th " " ..	+
			26th " " ..	+
			27th " " ..	+
			28th " " ..	+
			29th " " ..	+
			31st " " ..	+
			1st April " ..	+
			2nd " " ..	+
			3rd " " ..	+
41	I. 64	25th March 1913 ..	25th March 1913 ..	+
			26th " " ..	−
			27th " " ..	−
			28th " " ..	−
42	I. 65	25th March 1913 ..	25th March 191 ..	+
			26th " " ..	+
			27th " " ..	+
			28th " " ..	+
			29th " " ..	+
			31st " " ..	+
			1st April " ..	+
			2nd " " ..	+
			3rd " " ..	−
			4th " " ..	−
			5th " " ..	−
			7th " " ..	−
43	I. 66	24th March 1913 ..	24th March 1913 ..	+
			25th " " ..	+
			26th " " ..	+
			27th " " ..	+
			28th " " ..	+
			29th " " ..	+
			31st " " ..	+
			1st April " ..	+
			2nd " " ..	−
			3rd " " ..	−
			4th " " ..	−
44	I. 67	26th March 1913 ..	26th March 191 ..	+
			27th " " ..	+
			28th " " ..	+
			29th " " ..	+
			31st " " ..	+
			1st April " ..	−
			2nd " " ..	−
			3rd " " ..	−
45	I. 68	26th March 1913 ..	26th March 1913 ..	+
			27th " " ..	+
			28th " " ..	+
			29th " " ..	+
			31st " " ..	+
			1st April " ..	+
			2nd " " ..	+
			3rd " " ..	−
			4th " " ..	−
			5th " " ..	−

TABLE III.—(*Contd.*)

Serial No.	Number of case in the Register.	Date of passing stools.	Dates of examination of stools.	Presence, or absence, of comma bacillus in the stool.
46	I. 69	28th March 1913 ..	28th March 1913 ..	+
			29th „ „ ..	+
			31st „ „ ..	+
			1st April „ ..	+
			2nd „ „ ..	+
			3rd „ „ ..	−
			4th „ „ ..	−
			5th March „ ..	−
47	I. 71	31st March 1913 ..	31st March 1913 ..	+
			1st April „ ..	+
			2nd „ „ ..	+
			3rd „ „ ..	−
			4th „ „ ..	−
			5th „ „ ..	−
48	I. 72	31st March 1913 ..	31st March 1913 ..	+
			1st April „ ..	+
			2nd „ „ ..	+
			3rd „ „ ..	−
			4th „ „ ..	−
			5th „ „ ..	−
49	I. 75	1st April 1913 ..	1st April 1913 ..	+
			2nd „ „ ..	+
			3rd „ „ ..	+
			4th „ „ ..	+
			5th „ „ ..	−
			7th „ „ ..	−
			8th „ „ ..	−
50	I. 79	5th April 1913 ..	5th April 1913 ..	+
			7th „ „ ..	+
			8th „ „ ..	+
			9th „ „ ..	−
			10th „ „ ..	−
			12th „ „ ..	−
51	I. 85	8th April 1913 ..	8th April 1913 ..	+
			9th „ „ ..	−
			10th „ „ ..	−
			12th „ „ ..	−
52	I. 91	12th April 1913 ..	12th April 1913 ..	+
			13th „ „ ..	+
			14th „ „ ..	+
			15th „ „ ..	−
			16th „ „ ..	−
			17th „ „ ..	−
53	I. 95	16th April 1913 ..	16th April 1913 ..	+
			17th „ „ ..	−
			19th „ „ ..	−
			20th „ „ ..	−
54	I. 96	17th April 1913 ..	17th April 1913 ..	+
			19th „ „ ..	−
			20th „ „ ..	−
			21st „ „ ..	−
55	I. 99	17th April 1913 ..	17th April 1913 ..	+
			19th „ „ ..	+
			20th „ „ ..	+
			21st „ „ ..	+
			22nd „ „ ..	−
			23rd „ „ ..	−
			24th „ „ ..	−
56	I. 101	18th April 1913 ..	18th April 1913 ..	+
			19th „ „ ..	+
			20th „ „ ..	+
			21st „ „ ..	−
			22nd „ „ ..	−
			23rd „ „ ..	−
57	I. 104	21st April 1913 ..	21st April 1913 ..	−
			22nd „ „ ..	+
			23rd „ „ ..	+
			24th „ „ ..	+
			26th „ „ ..	−
			28th „ „ ..	−
			29th „ „ ..	..
58	I. 111	28th April 1913 ..	28th April 1913 ..	+
			29th „ „ ..	+
			1st May „ ..	+
			2nd „ „ ..	−
			3rd „ „ ..	−

TABLE III.—(*Contd.*)

Serial No.	Number of case in the Register.	Date of passing stools.	Dates of examination of stool.	Presence, or absence, of comma bacillus in the stool.
59	I. 92	15th April 1913 ..	15th April 1913 ..	+
			16th „ „ ..	+
			17th „ „ ..	+
			19th „ „ ..	−
			20th „ „ ..	−
			21st „ „ ..	−
60	I. 112	5th May 1913 ..	5th May 1913 ..	+
			6th „ „ ..	+
			7th „ „ ..	+
			8th „ „ ..	−
			9th „ „ ..	−
61	I. 113	6th May 1913 ..	6th May 1913 ..	+
			7th „ „ ..	−
			8th „ „	−
			9th „ „ ..	−
62	I. 115	9th May 1913 ..	9th May 1913 ..	+
			10th „ „ ..	−
			12th „ „ ..	−
			13th „ „ ..	−
63	I. 118	10th May 1913 ..	10th May 1913 ..	+
			12th „ „ ..	+
			13th „ „ ..	+
			14th „ „ ..	
			15th „ „ ..	−
			16th „ „ ..	−
64	I. 119	14th May 1913 ..	14th May 1913 ..	+
			15th „ „ ..	+
			16th „ „ ..	−
			17th „ „ ..	−
			19th „ „ ..	−
65	I. 126	23rd May 1913 ..	23rd May 1913 ..	+
			24th „ „ ..	−
			25th „ „ ..	−
			26th „ „ ..	−
66	I. 131	28th May 1913 ..	28th May 1913 ..	+
			29th „ „ ..	−
			30th „ „ ..	−
			31st „ „ ..	−
67	I. 132	29th May 1913 ..	29th May 1913 ..	+
			30th „ „ ..	−
			31st „ „ ..	−
			2nd June „ ..	−
68	I. 133	29th May 1913 ..	29th May 1913 ..	+
			30th „ „ ..	−
			31st „ „ ..	−
			2nd June „ ..	−
69	I. 134	29th May 1913 ..	29th May 1913 ..	+
			30th „ „ ..	−
			31st „ „ ..	−
			2nd June „ ..	−
70	I. 135	3rd June 1913 ..	3rd June 1913 ..	+
			4th „ „ ..	+
			5th „ „ ..	−
			6th „ „ ..	−
			7th „ „ ..	−
71	I. 139	4th June 1913 ..	4th June 1913 ..	+
			5th „ „ ..	−
			6th „ „ ..	−
			7th „ „ ..	−
72	I. 136	5th June 1913 ..	5th June 1913 ..	+
			6th „ „ ..	−
			7th „ „ ..	−
			8th August „ ..	−
73	I. 137	4th June 1913 ..	4th June 1913 ..	+
			5th „ „ ..	−
			6th „ „ ..	−
			7th „ „ ..	−
74	I. 138	5th June 1913 ..	5th June 1913 ..	+
			6th „ „ ..	−
			7th „ „ ..	−
			8th „ „ ..	−

TABLE III.—(*Contd.*)

Serial No.	Number of case in the Register.	Date of passing stools.	Dates of examination of stools.	Presence, or absence, of comma bacillus in the stool.
75	I. 140	6th June 1913 ..	6th June 1913 ..	+
			7th „ „ ..	+
			8th „ „ ..	−
			9th „ „ ..	−
			10th „ „ ..	−
76	I. 141	6th June 1913 ..	6th June 1913 ..	+
			7th „ „ ..	−
			8th „ „ ..	−
			9th „ „ ..	−
77	I. 142	9th June 1913 ..	9th June 1913 ..	+
			10th „ „ ..	−
			11th „ „ ..	−
			12th „ „ ..	−
78	I. 145	11th June 1913 ..	11th June 1913 ..	+
			12th „ „ ..	−
			13th „ „ ..	−
			14th „ „ ..	−
79	I. 146	12th June 1913 .	12th June 1913 ..	+
			13th „ „ ..	−
			14th „ „ ..	−
			16th „ „ ..	−
80	I. 147	12th June 1913	12th June 1913 ..	+
			13th „ „ ..	−
			14th „ „ ..	−
			16th „ „ ..	−
81	I. 149	16th June 1913 .	16th June 1913 ..	+
			17th „ „ ..	−
			18th „ „ ..	−
			19th „ „ ..	−
82	I. 150	18th June 1913 ..	18th June 1913 ..	+
			19th „ „ ..	+
			20th „ „ ..	−
			21st „ „ ..	−
			22nd „ „ ..	−
83	I. 151	22nd June 1913 . ..	22nd June 1913 ..	+
			24th „ „ ..	−
			25th „ „ ..	−
			26th „ „ ..	−
84	I. 154	10th June 1913 ..	10th June 1913 ..	+
			11th „ „ ..	−
			12th „ „ ..	−
			13th „ „ ..	−
85	I. 155	6th August 1913 ..	6th August 1913 ..	+
			7th „ „ ..	+
			8th „ „ ..	+
			9th „ „ ..	+
			10th „ „ ..	+
			11th „ „ ..	−
			12th „ „ ..	−
			13th „ „ ..	−
86	I. 156	6th August 1913 ..	6th August 1913 ..	+
			7th „ „ ..	−
			8th „ „ ..	−
87	I. 157	7th August 1913 ..	7th August 1913 ..	+
			8th „ „ ..	+
			9th „ „ ..	+
			10th „ „ ..	+
			11th „ „ ..	+
			12th „ „ ..	+
			13th „ „ ..	+
			14th „ „ ..	+
			15th „ „ ..	+
			16th „ „ ..	+
			17th „ „ ..	+
			18th „ „ ..	−
			19th „ „ ..	−
			20th „ „ ..	−
			21st „ „ ..	−
88	I. 160	28th August 1913 ..	28th August 1913 ..	+
			29th „ „ ..	+
			30th „ „ ..	+
			1st September 1913 ..	+
			2nd „ „ ..	+
			3rd „ „ ..	−
			4th „ „ ..	−
			5th „ „ ..	−

TABLE III.—(*Concld.*)

Serial No.	Number of case in the Register.	Date of passing stools.	Dates of examination of stool.	Presence, or absence, of comma bacillus in the stool.
89	I. 161	1st September 1913 ..	1st September 1913 ..	+
			2nd „ „ ..	+
			3rd „ „ ..	+
			4th „ „ ..	+
			5th „ „ ..	−
			6th „ „ ..	−
			7th „ „ ..	−
			8th „ „ ..	−
90	I. 162	2nd September 1913 ..	2nd September 1913 ..	+
			3rd „ „ ..	+
			4th „ „ ..	+
			5th „ „ ..	+
			6th „ „ ..	+
			8th „ „ ..	−
			9th „ „ ..	−
91	I. 165	25th September 1913 ..	25th September 1913 ..	+
			26th „ „ ..	+
			27th „ „ ..	+
			29th „ „ ..	+
			30th „ „ ..	−
			1st October „ ..	−
			2nd „ „ ..	−
92	I. 166	10th October 1913 ..	10th October 1913 ..	+
			11th „ „ ..	+
			12th „ „ ..	+
			13th „ „ ..	−
			14th „ „ ..	−
			15th „ „ ..	−
93	I. 169	12th October 1913 ..	12th October 1913 ..	+
			13th „ „ ..	+
			14th „ „ ..	+
			15th „ „ ..	+
			16th „ „ ..	−
			17th „ „ ..	−
			18th „ „ ..	−
94	I. 170	13th October 1913 ..	13th October 1913 ..	+
			14th „ „ ..	+
			15th „ „ ..	+
			16th „ „ ..	+
			17th „ „ ..	−
			18th „ „ ..	−
			20th „ „ ..	−

TABLE IV.

The following table shows the months in which examinations were made, the number of stools containing cholera vibrios examined, and the duration of life of the cholera vibrios :—

Months examinations were made.	Number of stools containing cholera vibrios examined.	DURATION IN DAYS OF LIFE OF CHOLERA VIBRIOS.		
		Minimum.	Maximum.	Average.
December 1912	9	10	10	3·6
January 1913	6	1	12	6·6
February „	13	3	17	7·7
March „	20	1	13	6·5
April „	22	1	5	2·8
May „	10	1	3	1·4
June „	15	1	2	1·2
July „	..	..	..	..
August „	4	1	12	6·0
September „	3	4	5	4·3
October „	3	3	4	3·7

TABLE V.

The following table shows the date of passing of stool, dates of examinations, the number of cholera vibrios per c.c. of stool, and death-rate of cholera vibrios populating 1 c.c. of rice-water stool :—

Serial No.	Registered No. of case.	Date of passing stool.	Date of examination.	Number of cholera vibrios per c.c. of rice-water stool.	Mortality amongst cholera vibrios populating 1 c.c. rice-water stool.
	I. 161	1-9-13	1-9-13	200,000,000	200,000,000 in 4 days.
			2-9-13	500,000	
			3-9-13	+ 1 c.c.	
			4-9-13	+ 1 c.c.	
			5-9-13	— 5 c.c.	
			6-9-13	—10 c.c.	
			8-9-13	—20 c.c.	
			9-9-13	—remainder of stool.	
2	I. 162	2-9-13	2-9-13	145,000,000	145,000,000 in 5 days.
			3-9-13	5,000,000	
			4-9-13	100,000	
			5-9-13	10,000	
			6-9-13	+ 1 c.c.	
			8-9-13	—20 c.c.	
			9-9-13	—40 c.c.	
			10-9-13	—remainder of stool.	
3	I. 165	25-9-13	25-9-13	850,000,000	850,000,000 in 5 days.
			26-9-13	90,000,000	
			27-9-13	8,000,000	
			29-9-13	+ 1 c.c.	
			30-9-13	—10 c.c.	
			1-10-13	—20 c.c.	
			2-10-13	—remainder of stool.	
4	I. 166	10-10-13	10-10-13	500,000,000	500,000,000 in 3 days.
			11-10-13	15,000,000	
			12-10-13	+ 1 c.c.	
			13-10-13	— 1 c.c.	
			14-10-13	— 5 c.c.	
			15-10-13	—10 c.c.	
			16-10-13	—20 c.c.	
			17-10-13	—remainder of stool.	
5	I. 169	12-10-13	12-10-13	2,000,000,000	2,000,000,000 in 4 days.
			13-10-13	300,000,000	
			14-10-13	40,000,000	
			15-10-13	+ 1 c.c.	
			16-10-13	— 5 c.c.	
			17-10-13	—10 c.c.	
			18-10-13	—20 c.c.	
			19-10-13	remainder of stool.	
6	I. 170	13-10-13	13-10-13	700,000,000	700,000,000 in 4 days.
			14-10-13	54,000,000	
			15-10-13	6,000,000	
			16-10-13	+ 1 c.c.	
			17-10-13	—10 c.c.	
			18-10-13	—20 c.c.	
			19-10-13	—remainder of stool.	

It may be convenient to mention here the following meteorological facts(12) :—

In Calcutta the mean temperature averages 79°F., the mean maximum being 102°F. in May, and the mean minimum 48°F. in January. The average temperature in the hot season is 85°F., in the rains 83°F., and in the cold season 72°F. Humidity averages 78 per cent. in March to 89 per cent. in August. The annual rainfall averages 60 inches, and the average number of rainy days in the year is 118.

From a study of the results certain interesting points arise. In the first place, as was shown by my previous research(5) to be the case in B. typhosus, the life of the cholera vibrio outside the human host under natural conditions in India is short ; there is considerable variation, however, in regard to the vitality amongst the individual strains.

Temperature has a powerful influence on the vitality of the cholera vibrio outside the human host. Thus as the hot season in Calcutta, from March to June advances, the life of the organism becomes shorter ; in the present research the minimum duration of life was reached in June. On the other hand, from December

to February, the cold season, the vitality is greater, and the maximum duration of life occurred in February. Again in August when the monsoon has fully developed and the temperature has fallen somewhat the life is longer than in the hot season ; but as the number of cases of cholera during August and September is small my observations during this period were fewer.

CHART.

The accompanying chart shows graphically the duration of life of the cholera vibrio in rice-water stools in the various months in Calcutta.

Houston (10) has shown that the life of the B. typhosus in raw Thames water varies with the temperature, being longer at lower and shorter at higher temperature.

The critical months in Calcutta as regards temperature are December, January and February, and it has been shown in the present research that the vitality of the cholera vibrio in the rice-water stool is highest during these months.

It is interesting to note that the critical cholera months in Calcutta follow directly the low temperature months.

The cholera vibrios discharged from " porters " or actual cases in low temperature months will be potentially more dangerous than those discharged in high temperature months, other conditions being similar.

These facts which I have brought forward are in themselves interesting and important, but they attain a greater importance and interest when considered in conjunction with the problems which I dealt with (1, 2, 3, 4) at the last Conference.

From the moment of leaving the human host the hour of the cholera vibrio has struck, as the death-rate of this delicate organism apart from the host is extremely high (*vide* Table V), and in a comparatively short time it becomes extinct. Accurate experimental evidence affords no support to the view that the endemic prevalence of cholera depends on the vitality of the cholera vibrio outside man. On the other hand, scientific research has shown(1) that in certain portions of the body of man, namely, the biliary passages, the organism finds conditions suitable in all respects for continuing its life. The bile is an excellent medium for the growth of the cholera vibrio and it finds there an absence of other organisms. I pointed out at the last Conference the important part played by man in the spread of cholera in India.(2) Dr. A. C. Houston (11), Director of Water Examinations, Metropolitan Water Board, in his last Research Report recently published makes some interesting remarks in this connection. Thus page 7 :—" So far as infectious disease is concerned the real enemy of mankind is man, and the dose of poison is probably such an active factor in causing infection that we ought to guard ourselves against the individual as potential concentrator of infection.

" If the immediate cause of what are recognised as ' water epidemics ' in the past could be precisely ascertained, I believe in most cases it would be found that accidental infection of the supply by what is known as a ' porter 'or ' carrier ' of disease has occurred."

Also page 13 :—" The home of the typhoid bacilli is not so much in impure water or even in the crude sewage from a large community as in the ' factories ' of disease as exemplified by the ' carrier case. ' "

The danger of pollution (volume for volume) would seem to rank as follows :—

1. The carrier unit—the concentrator and the factory of disease—the genesis of epidemics.
2. The unit person of unknown health history who may be in the position of (1), and is therefore in a potential sense placed second but who, in the great majority of cases, one would hope, is an almost negligible factor.
3. The collection of individuals on a large scale, exemplified, in a contaminating sense, by the sewage of a large town. Here the dangerous " carrier element " being reduced by dilution to normal proportions, less than one typhoid bacillus per ·001 c.c. of sewage might be anticipated to be present on the basis of the foregoing observations."

My researches in India, commenced seven years ago, on enteric fever and cholera lead me to agree fully with the remarks of Dr. Houston in regard to the importance of the " carrier " factor in the propagation of these diseases. At one time in India the tactics employed in the campaign against enteric fever amongst the troops were based on the assumption that the virus of the disease existed chiefly outside the human host, particularly in water. These tactics failed in their object, and subsequent investigation explained the reasons for the failure, namely, that the factory of the virus of the disease is man himself, and the vitality of the organism of enteric fever under natural conditions outside the host was strictly limited. A fresh campaign, based on the knowledge acquired by our researches, was commenced and met with brilliant success as I showed at the last Conference.(8)

In regard to the prevention of cholera the lead which the recent bacteriological research gives to the practical sanitarian is to so arrange his tactics as to concentrate his attack on the human element because this dominates the situation. The human reservoir is in a position to supply an adequate dose of the poison to the various distributing channels—water, milk, flies, etc., and so initiate epidemics of cholera. Thus a water-supply may fulfil in every respect the requirements of a modern hygienist, but should it happen that a single "porter" of organisms is employed on the water-works there is a very great risk of this concentrator of the poison invalidating all the numerous and costly precautions taken to provide a pure supply by adding to the water on its way to the consumer an infective dose of the virus. The same statement would hold good in regard to milk-supplies, food-supplies, etc.

Hence it will be apparent that at present it is entirely a matter of good or bad luck for mankind whether his water, his milk, his food-supply, etc., escapes or does not escape from receiving an infective dose of the cholera vibrio from a factory of the virus, the human "carrier," because the latter—the most dangerous element in the situation—is unrecognized and therefore uncontrolled. It is obvious that until we are in a position to detect and bring under subjection this factor the eradication of cholera in India will be difficult. The philosophic expression, "*Combien il est dangereux d'être homme,*" may be applied, not inaptly, in regard to the etiology of cholera.

The problem of the prevention of the spread of cholera shortly stated is the protection of mankind from man.

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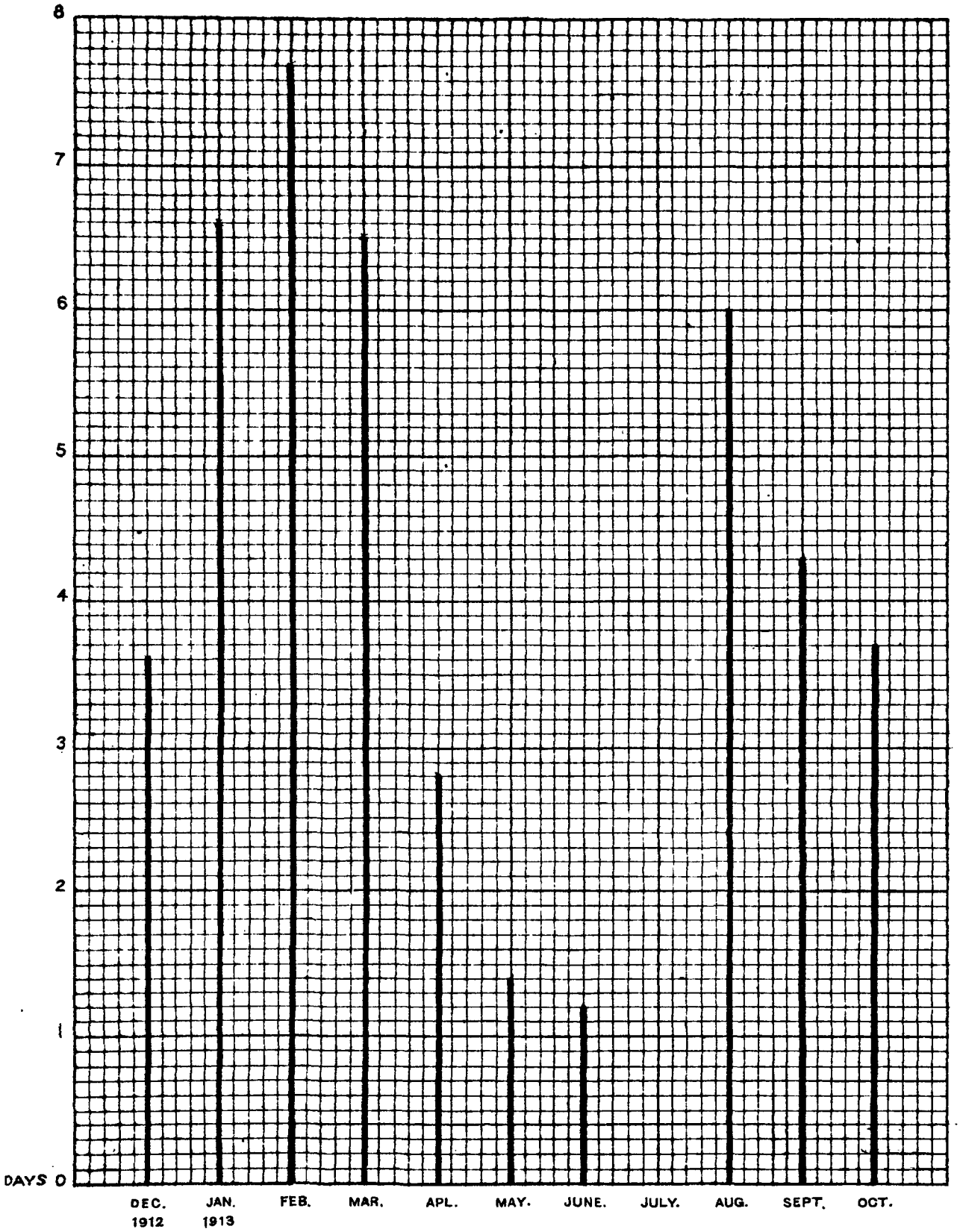
AVERAGE DURATION IN DAYS OF LIFE OF CHOLERA VIBRIO



MEAN AVERAGE TEMPERATURE OF CALCUTTA = 79° F.

" MAXIMUM " " " = 102° F.
(In May)

" MINIMUM " " " = 48° F.
(In Jan.)

"

A SHORT NOTE ON CHOLERA AS AN ENDEMIC IN COSSIPUR-CHITPUR, BENGAL.

BY

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CHOLERA is an important factor of mortality in Bengal. As Health Officer of Cossipur-Chitpur I have had special opportunity of studying it as an endemic. I hope the following lines will prove of some interest to those who have to deal with sanitation in the Province.

Next to malaria, cholera is the disease which carries off year after year the largest number of victims in the Presidency. Of deaths due to malaria, we have no account, "fever" in official registers includes fevers other than malarial, and even if it were meant for malaria only, entries from ignorant reporters by equally ignorant registrars are anything but reliable. Not so with cholera, the symptoms of the disease and the course it runs are too characteristic to escape attention. As a matter of fact in our town, of 778 deaths registered under cholera that were investigated in course of the last five years, 742, *i.e.*, 95·4% were found to be due to that disease and of 762 deaths from cholera, only 20, *i.e.*, 2·6% were registered under other heads.

RESULT OF INVESTIGATION INTO DEATHS FROM CHOLERA IN COSSIPUR-CHITPUR DURING 1908 TO 1912.

Year.	Deaths registered under cholera.		Cholera deaths registered under other heads.	Percentage of deaths registered as Cholera found actually due to that disease.	Percentage of Cholera deaths entered under other heads.
	Total.	Found actually due to Cholera.			
1908	168	165	*Nil.*	98·2	*Nil.*
1909	102	92	2	90·1	2·1
1910	91	83	8	91·2	8·8
1911	143	132	3	92·3	2·2
1912	274	270	7	98·5	2·5
TOTAL ..	778	742	20	95·4	2 6

As the reporting and registering agencies are practically the same throughout the province, we may fairly conclude that deaths from cholera are almost all registered as such and that deaths from other diseases are rarely mixed with it. If so, the share of the disease in the annual mortality of the province during the last five years was on an average as follows :—

Town or Village.	Total mortality per mille per annum.	Cholera mortality per mille per annum.	Percentage due to Cholera.
Urban	24·73	2·97	12·0
Rural	29·31	2·41	8·2
Of the whole Province	29·02	2·45	8·4

As I have said above, cholera is endemic in our town; scarcely a month passes but there are some cases of it. The following table shows mortality from cholera

in the town per mille of the population during the last ten years and the ratio it bears to the total mortality :—

Year.	Total mortality per mille per annum.	Mortality from Cholera.	
		Mortality per mille per annum.	Ratio per cent. of total mortality.
1903	34·39	3·49	10·2
1904	29·83	3·69	12·4
1905	36·29	3·75	10·3
1906	34·19	4·92	14·3
1907	40·55	7·09	17·7
1908	30·30	4·66	15·8
1909	28·71	1·86	6·5
1910	23·62	1·91	7·9
1911	27·40	2·70	10·1
1912	32·49	5·61	17·3

The following points, I think, are of importance as bearing on the endemicity of the disease :—

(A) Population.

1. *Fairs.*—No fair is held within the town. But the influx of pilgrims from outside and of people from mofussil who come in crowds on special festivals to bathe in the holy river Hughli is always marked by cholera breaking out among the pilgrims themselves and among the residents. Thus during the Arddhodaya Yoga of 1908, the former returned no less than eighty fatal cases.

2. *Immigrants.*—The population of the town itself consists largely of temporary elements coming from and going back to all parts of the Presidency and the neighbouring Provinces.

Number of persons of different districts in Bengal and other Provinces found residing in the town during the Census of 1911.

Province or Country (if outside India).		Number of districts contributing to the population.	Actual number of persons.	Percentage to total population.
	Name.			
British India.	Bengal	26	26,047	55·69
	Bihar, Chota Nagpur and Orissa	22	6,925	14·80
	United Provinces of Agra and Oudh ..	32	12,871	27·51
	Punjab	18	258	·55
	Assam	6	50	
	Ajmere	2	19	
	Central Provinces	2	4	
	Berar	1	1	
	Bombay	8 (including Portuguese Goa)	46	
	Madras	3 (including 2 Native States)	12	
	Burma	1	7	
Native States	Central India	4 (States)	82	
	Kashmir	....	7	
	Mysore	....	1	
	Rajputana	6 (States)	279	·59
	Nepal	....	13	
	Indefinite	....	41	
	Foreign Countries	....	115	
	Total	....	46,778 *	

* Excluding population of Railway Quarters, Seven Tanks Quarters and Gun and Shell Factory.

With people pouring constantly into it from villages and towns scattered over such an extensive area, the chance of frequent importation of the disease can well be imagined.

3. *Probable local carriers.*—The disease occasionally tends to cling to the infected houses in spite of the most thorough disinfection. Some of the houses in which

such recrudescence was observed during the last six years are shown in the following table :—

Holdings.	1908.	1909.	1910.	1911.	1912.	1913.
8/6 Barrackpur Trunk Road.	....	1 fatal in April.	1 fatal in October.	....	1 fatal in May.	....
9/19 Barrackpur Trunk Road.	1 fatal in October.	....	....	1 fatal in October.	....	....
52 Barrackpur Trunk Road.	....	1 fatal in November.	1 cured in December.	....	....	1 fatal in April.
58/2 Barrackpur Trunk Road.	....	....	1 fatal in March.	....	1 fatal in November.	1 fatal in May.
5 Gopal Chunder Mukherjee Road.	....	1 fatal in October.	1 fatal in April. 1 fatal in December.	....	1 fatal in April.	....
1/50 Ghoshbagan Lane.	....	....	....	1 fatal in August.	1 fatal in January.	1 fatal in March.
8 Nawabputty Street.	....	....	1 fatal in April.	1 cured in January.	....	1 fatal in May.
2 Seal's Garden Lane.	....	....	1 fatal in August.	1 fatal in August.	1 fatal in January.	....
43 Cossipur Road	....	....	1 cured in December.	1 cured in January.	1 fatal in January.	....
14 Gun Foundry Road.	1 fatal in February.	....	1 fatal in March.	1 fatal in January.	1 fatal in March. 1 fatal in April. 1 fatal in October.	....

For the houses where the infection is known to persist, there may be others where it is equally tenacious but escapes notice because it is not marked by fatal cases.

Cases are still more numerous where the disease reappears in the houses close to those which were visited in the preceding epidemic.

(B) Meteorological Conditions.

1. *Rainfall.*—The endemic comes down and is at its lowest during the monsoon. It begins to make head again with the cessation of the rains. In those years in which rainfall is excessive, the height is not reached till after the winter, *i.e.*, after the month of March; but in ordinary years, the endemic is in full swing and in some years at its climax in the months of November, December and January.

2. *Temperature.*—Temperature does not seem to have much effect except when the average is below 72° F. during the coldest part of the year, the disease coming down again though not to the same extent as during the rains. As the joint effect of temperature and rainfall in ordinary years, the mortality curve of the disease shows a remarkable double rise, *viz.*, once during early winter, *i.e.*, November, December and first fortnight of January and again in early summer, *i.e.*, in April and May.

3. *Winds.*—Outbreaks in the localities near the night-soil trenching ground are often synchronous with the direction of the wind.

Table showing months in which Cholera broke out in the villages round the night-soil trenching ground during 1906 to 1911 and their relation to the wind blowing from it.

Village.	Year.					
	1906.	1907.	1908.	1909.	1910.	1911.
Nowpara ..	August ..	*October* ..	April	March	*December*	*February*, March, August, *September*, *November*, *December*.
Sinthe ..	May, *December*.	*November*, *December*.	..	May	*February*	June, July, August, *September*, *October*.
Matikola ..	*July* ..	*March* ..	*April* ..	..	..	*March*, *July*.
Garui ..	December	December	*March* ..		*September*	....

Shows that the wind blew in that direction.

Flies.—The house flies which infest the town during the rest of the year are greatly reduced and even disappear during the rainy season and are again less in evidence though not so markedly during the coldest part of the winter; so that in this respect their statistics run parallel to the seasonal intensity of the endemic. As regards winds, flies are undoubtedly wafted by them from the night-soil trenching-ground to the neighbouring villages.

Tanks.—How the tanks cease to disseminate cholera during rains is difficult to understand; for during the season risk of infection is increased, as the tanks, in addition to the direct pollution by the people bathing and washing in them, receive storm-water washing down the filthy yards and surrounding of the huts and houses.

During the monsoon, however, water of the tanks as a rule improves, foul smelling putrefactive processes ceasing with dilution and oxygenation. Probably the altered condition of the water inhibits in some way growth and virulence of the vibrio.

(C) Condition of the Town.

1. *Sanitary Arrangements.*

(*a*) *Service Privies.*—Night-soil remains more or less exposed to the flies for 24 hours before it is removed the next morning. Under the existing system, the filth receptacle though movable is never removed and washed, the soil being simply scooped out with a piece of earthenware ('sara'), the receptacle gets a coating of putrid night-soil which is replenished every day as it is cleared; this coating not only hastens putrefaction in the fresh deposit and causing a nuisance which attracts flies, but it also affords an excellent nursery for the maggots which between their being hatched out of the eggs and emerging as imagoes get ample opportunity for ingesting what pathogenic bacteria the fæces might contain. Such imagoes with their alimentary canal loaded with active bacteria must be far more dangerous disseminators of the disease than the adult visitors getting a smear of the filth.

(*b*) *Trenching-ground.*—Our trenching-ground is about three miles from the town. But for the extreme dearth of coolies in the current year, it is one of the best managed; there is practically no nuisance here, in fact the only nuisance is what occurs during emptying of the night-soil carts; flies are not so common. The facts have been repeatedly borne out by the visitors; still I have no doubt it does contribute materially to the fly pestilence in the neighbouring villages and is, I am afraid, accountable as one of the factors at any rate for occasional outbreaks of cholera in them.

2. *Water.*—Heavy as the mortality from cholera is at present, the havoc wrought by it in the town before the introduction of filtered water was appalling. We would have been in the dark as to its ravages in those days if the Municipal Commissioners had not kept the register during the years 1889 to 1891. These were the first three years after the creation of the Municipality; arrangement for registration of vital events could not possibly have been satisfactory; and so the register could not possibly have been complete. Still comparison of cholera mortality according to the register of those years, with the mortality which obtains at present shows that the rate has been greatly reduced.

Year.	Average Mortality per mille per annum according to Official Register.		Remarks.
	From cholera.	Total.	
1889 to 1891 ..	7·98	39·35	Register incomplete. Actual deaths probably ⅓rd more than registered.
1910 to 1912 ..	3·40	27·83	Register about complete.

3. *Tanks.*—Filtered water is now used for drinking. But the tanks are still resorted to for all domestic purposes including washing of cups, plates and tumblers which while yet wet are used for keeping water, milk and other articles of food; and these tanks are also freely polluted by bathing and washing dirty clothes including soiled ones, the people not hesitating to wash in them even the rags soiled with infectious dejecta. This is specially the case in bastis, the huts of which are dwelt in by immigrants from various parts of the country as stated above. Contamination of water no doubt accounts partly for the endemicity of cholera in—

(*a*) bastis with tanks used by the people, and

(*b*) round tanks used by the "dhobies" for washing clothes of their customers.

(*a*) DEATHS FROM CHOLERA IN BASTIS WITH TANKS USED BY THE PEOPLE DURING THE QUINQUENNIUM 1908 TO 1912.

Basti.	Population average.	1908.	1909.	1910.	1911.	1912.	Average.
Ghoshbagan	2,549	14	5	7	1	11	7
Subadarbagan and Lichubagan	292	3	1	3	2	4	8
Matijhil	1,741	12	13	5	2	10	3
Uriapara	691	4	1	3	3	5	8
Bysackbagan	2,586	9	2	1	16	10	2
Kumar Harish Chandra Roy's basti	817	4	6	4	6	1	4
Narkolbagan	784	3	1	3	9	5	4
Seal's Garden Lane ..	50	0	0	1	2	4	2
Tikiapara	1,017	2	4	2	0	2	2
Nulanpara	1,021	5	2	0	3	6	3
Anath Babu's basti; 68, Belgachia Road	4,217	5	3	4	24	28	13
1, Dakhindari Road basti ..	52	2	1	2	2	1	2
Nilmani Mitter Street ..	865	0	0	3	1	11	3
Actual number ..	16,682	63	39	38	71	98	62
Total							
Mortality per mille per annum.. ..	....	3·77	2·33	2·33	4·25	5·87	3·70
WHOLE TOWN:							
Mortality per mille per annum .	48,352	4·66	1·86	1·91	2·70	5·61	3·35

(*b*) DEATHS FROM CHOLERA ROUND TANKS USED BY THE 'DHOBIES' DURING THE QUINQUENNIUM 1908 TO 1912.

Locality.	1908.	1909.	1910.	1911.	1912.	REMARKS.
Jhererbagan	4	0	0	4	12	
Deerebagan	2	0	2	1	1	
Jhil at Paramanick Ghat Road ..	2	2	1	1	2	
Ushangini Debi's basti; 2, Dum-Dum Road	2	3	0	2	6	

3. *Gowala bastis.*—The disease is fairly frequent in gowala bastis as will be evident from the following table :—

Gowala basti.	1908.	1909.	1910.	1911.	1912.	REMARKS.
Narkolbagan	3	1	1	3	1	
Raja Narsingh's bagan	3	1	0	2	10	
Chanakhoti and Rangalal Bysack's basti; 6 & 7, Dum-Dum Road	2	2	0	3	0	

From the above it would appear that the endemicity of the disease in this town depends, mainly at any rate, on immigrants arriving with the disease from outside and local carriers and on its spread chiefly by water and also by flies.

In our attempts to check it we are confronted with the following difficulties :—

(1) DIFFICULTY IN GETTING PROMPT INFORMATION OF OCCURRENCE OF THE DISEASE.

To be able to cope with an outbreak it is essential that measures should be taken at the very onset at the very earliest stage of the epidemic ; but this is rarely possible under the existing circumstances.

Notification is not compulsory. But even if it were compulsory, it would have been of little avail. Cases which come under the care of qualified medical men are often reported to us by them ; but the majority of patients are not treated by them and quite a large proportion go without any treatment whatever.

(2) IGNORANCE OF THE PEOPLE.

Ignorant and reckless as the basti people are, it often proves very troublesome to manage them during an epidemic. However disinfections carried on

among them serve as so many object lessons and demonstrations; the opportunities are also utilised in giving instruction; and leaflets in vernacular on cholera are circulated among them (a copy in English is appended with this paper*), much cannot be expected; but that the attempt has not altogether been wasted is evident from the fact that nowadays we do not notice earthenware pots ("saras") with dejecta of cholera patients thrown on or near the tanks used by the people as was only too frequently the case some seven years ago.

(3) Difficulty in controlling water.

(1) *Public Supply.*—Filtered water used for drinking only having greatly reduced cholera, it stands to reason that the supply should be ample and that the people should use it for all sorts of domestic purposes as well. But it is also a question of finance; the water rate will have to be increased, and as this rate is levied on assessed values of properties and not on persons per head, the brunt of the increase will fall out of all proportion on the richer people, for instance, in our town, on the proprietors of the Jute Presses. Hence the Municipal Commissioners are averse to taking such a step.

In passing, it may be remarked that the excellent suggestion contained in Section 199 of the Bengal Municipal Act, *viz.*, providing three sets of tanks, one for drinking and culinary purposes, another for bathing only, and a third for washing and all other purposes connected with sanitation and cleanliness, though within the means of the poorest town have not so much been carried into effect.

(2) *Private Tanks and Wells* (*a*).—Those actually contaminated with infectious material come within the meaning of Section 199A, Bengal Municipal Act. The section provides a tardy remedy between the water being sent to the Civil Surgeon of the District for examination and the Civil Surgeon sending his report, the disease gets sufficient time to spread far and wide and thus slip out of control. The amendment proposes to transfer the power from the Civil Surgeons to the Health Officers; but it is also necessary that such water should be prohibited not only for drinking as in the existing section, but for all other domestic purposes as well; further such tanks should be guarded by Police constables who should arrest such persons as may use the water in spite of warning, and prosecute them.

(*b*) Unwholesome tanks and wells are dealt with under Section 200, Bengal Municipal Act. Paragraph 24, Cir. No. 34-M., dated Calcutta, the 27th August 1894, from the Officiating Secretary to the Government of Bengal, to all Commissioners of Divisions gives a very wide latitude to the owners of such tanks and wells. They may either re-excavate or fill up or cleanse them at their option and 'the Commissioners are not entitled by the law to dictate to the owner which of the three courses open to him he is to pursue.' The section, however, seems to mean that when mere cleansing is all that is necessary, the Municipal Commissioners may require the owner accordingly and the owner may cleanse it; but, instead, he may fill up or re-excavate it and to such step the Commissioners, of course, cannot take objection. But in other cases when the tank or well cannot be made wholesome by mere cleansing, the Commissioner can require the owner either to fill up or re-excavate it and the owner may choose either of these two alternatives, *i.e.*, he must either fill up or re-excavate it and not merely cleanse it. This is at any rate the interpretation of Mr. Pargiter in his edition of the Bengal Municipal Act (page 179, Edition 1904).

Even then the section is defective. Mere re-excavation cannot improve any well, it should at least be provided with a pucca well cemented parapet and a pucca well cemented yard round it of sufficient width, and a pucca well cemented surface drain carrying waste water off from the well. Tanks too cannot be improved by re-excavation unless steps are taken to prevent subsequent pollution, as by providing raised borders, say 30 feet wide cutting of drainage from the surrounding land running into the tanks, having no hut, house or any other structure on them and not used as field for raising crops or vegetables and so requiring manuring. But there is nothing in the section or in any other section of the Act authorising the Municipal Commissioners to dictate in such cases, conditions which would ensure wholesomeness after the tanks and wells have been re-excavated. Neither can they make bye-laws on the points unless tanks and wells open to pollution be deemed as nuisance within the meaning of clause (*c*) of Section 350 of the Act; matters the Commissioners can deal with by making bye-laws have been specified in Section 350 and they cannot go beyond them.

(*c*) Dhobies should on no account be allowed to wash clothes of their customers in tanks used by the public. The practice, as we have seen above, is fraught with risk of disease to the people and so comes under Section 268 of the Indian Penal Code. The Municipality should provide them with tanks for the purpose.

(*d*) Importance of pure water only in connection with dairies as proposed in the draft rules under Section 263, Bengal Municipal Act, circulated among the Bengal Municipalities will be evident when one remembers the frequency with which the disease breaks out in them.

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* Printed on page 111.

(4) Conservancy.

In the places where water is available, trenching of night-soil should be a thing of the past. However carefully managed, trenching-grounds are sure to breed flies; and with increasing dearth of coolies, management of trenching-grounds is becoming a problem. Septic tanks, though they involve heavy initial cost, are cheaper in the long run, require only a few men to work and are free from the risk of fly-breeding; and the effluent can be utilised by irrigating fields instead of being run into any river.

Service privies are necessary evils. Most of the towns are too poor to have water closets. But service privies in their existing state mean breeding of flies under the most favourable condition for spread of cholera and other filth diseases. Flies however can be materially reduced—

(1) if the room below squatting platform be kept dark by efficient walls and well-fitting trap door;
(2) if the receptacle and the floor be frequently treated with some antiseptic which will keep off or kill the flies; or
(3) if the receptacle be daily washed.

As regards (1) though well-fitting trap doors are a necessary condition of efficiency, they are frequently broken exposing the receptacles and much time elapses before they can be replaced.

As to measure (2) though it is resorted to during epidemics, chloride of lime being applied to the receptacles and floors of all privies in infected localities, it is too costly for systematic use.

Measure (3) is the pail system proper; in a warm climate like this, the pails will have to be daily cleansed and washed; this will require two sets of pails; the filled pails should be replaced with the clean ones every morning and removed to depôts, emptied, washed and kept ready for the next day. But it will require a much larger number of men and hence will be expensive unless combined with septic tanks at the depôt saving the cost of removal to the trenching-ground and of trenching the night-soil; besides, one must remember the difficulty in getting sweepers. I do not know if the pail system on this principle has been tried in a town like ours, *i.e.*, for a population of about 50,000. However it is at any rate worth trying.

CHOLERA.*

The public should try their best to prevent occurrence and spread of a dangerous disease like cholera among them. Cholera is characterised by rice-watery motions, collapse and suppression of urine.

The cause of cholera is a minute form of living organisms which from their fancied resemblance to the stop (,) are called comma bacilli. They are too minute to be seen without a microscope.

The disease is very infectious.—If a case of cholera occurs in a basti or a locality, it spreads from the patient to other inmates of the house as well as to the neighbouring people; thus in this town over hundreds of persons on an average die every year of this disease. But if measures be taken to stamp out or eliminate the means of its spread, it ceases to prove a danger to other people; in hospitals, the doctors, attendants and patients suffering from other diseases never catch infection from cholera patients.

How does cholera spread from the patient to healthy people? The stools of a cholera patient teem with comma bacilli. It is from the stools that the disease is spread by the following agencies:—

1. *Hand.*—If one handles or touches a cholera patient or his soiled clothes, etc., some comma bacilli may stick to his hand.

2. *Water.*—Tanks, wells, rivers or any other sources of water used by the public may be infected with comma bacilli by throwing cholera stools or washing clothes, etc., soiled with cholera stools in or near them. It is a matter of deep regret, that the people wash the soiled clothes, etc., of the patient in the very tank they use for domestic purposes; some do not hesitate even to throw "saras" (earthenware pots) full of cholera stools into or near the water edge of such tanks.

3. *Food.*—Milk and other articles of food are inoculated with the comma bacilli:—

(1) By being touched with infected hand;
(2) By flies which drop on them after lighting on cholera motions; or
(3) By being mixed with water or by being kept in vessels washed with such water.

Through which channel does it get into the body? If the hand thus infected be put into the mouth, or if water or food so infected be taken, the comma bacilli enter with them through the mouth into the intestines.

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* Translation of a Vernacular leaflet for circulation in Cossipur-Chitpur Municipality.

Once in the intestines, under suitable conditions, they multiply rapidly ; thus a few only may bring about a virulent attack.

I. How to prevent infection.

1. *Stools* are *the only discharges* from the patient *which contain the comma bacilli.*

Cholera stools should on no account be exposed to flies. The flies with their legs and bodies covered with fine hair act as swabs to carry the comma bacilli from the stools and inoculate food with them.

Do not throw cholera stools into or near any tank, well, river or other sources of water used by the people.

But pour on the stools at once, some Cyllin lotion or any other reliable lotion that will destroy comma bacilli.

2. *Soiled clothes, etc.*

Do not wash them, on any account in or near any tank or any other source of water used by the people. It is by washing clothes soiled with cholera stools in the very tank they use for washing mouth and cleansing plates, cups and tumblers, which they use for keeping water and milk and food that the people spread infection among themselves ; it is this recklessness that accounts for the local heavy mortality from cholera.

Soiled rags, etc., that are of no further use should on no account be thrown here and there ; if you do that, flies will light on them and spread the infection.

Neither should such rags be buried in ground, for a shower of rain may wash the infection into a neighbouring tank or well.

But put all soiled clothes, rags, etc., and other infected articles at once into Cyllin lotion, or some such reliable lotion and keep them immersed in it.

Clothes and other articles that are to be used again may be taken out of the lotion after two hours and washed in the house.

Useless rags, etc., should be kept in the lotion and burnt with kerosine at convenience. Of course they might be burnt at once without being put into the lotion ; but if that be impossible, they should at once be put into the lotion ; they should, on no account, be kept exposed to the flies.

3. *The hands of the attendants.*

Washing with plain water or even with soap and water is not enough, for a few comma bacilli may remain behind sticking to the hand,—they are so minute ; and the few organisms, on the hand being put into the mouth or taking food and drink touched with it, may get into the body and there under suitable condition, may start a fatal attack.

Therefore, whenever one touches a cholera patient or his clothes, etc., one should never forget to wash the hands with Cyllin lotion or some other reliable lotion.

II. General Rules.

1. *Acid medium kills comma bacilli.*

(1) The natural secretion of the stomach is acid. Therefore keep stomach healthy—

(*a*) Avoid all rotten or indigestible articles.

(*b*) If you have dyspepsia or diarrhœa get yourself treated at once.

(2) Take ' dahi ' diluted with water daily ; ' dahi ' contains a species of living organisms which produce acid, the comma bacilli will have less chance in the intestines in their presence.

Flies.—Foul smell attracts flies which feed on night-soil, dung and other decomposing animal and vegetable organic matter and breed in them. Hence they infect such bastis and localities as are polluted with sewage, offensive matter and rubbish. If cholera occurs in such localities, it is rapidly spread by the flies among a large number of people. Therefore—

(1) Do not expose food and drink to flies.

(2) Keep the house, its privy, drains and surroundings clear of all offensive matter. Treat privies and drains with phenyle or some such deodorant.

(3) Tanks, rivers, etc. It is dangerous to use water of the tanks open to the people for drinking, or washing mouth or cleansing plates, cups and tumblers ; specially, when a case of cholera occurs in a basti, one should not use such tanks for domestic purposes on any account, as it is impossible to count upon the good sense of all the people of the locality to abstain from washing clothes soiled with cholera motion in such tanks.

N.B.—If a case of cholera occurs in any house or holding within the Cossipur-Chitpur Municipality, the owners and occupiers thereof are requested to inform me of the case without delay, to help us in taking preventive measures and to carry out our instructions.

RELAPSING FEVER IN THE MEERUT DIVISION.

BY

MAJOR E. BISSET, M.B., D.P.H., I.M.S.,

Deputy Sanitary Commissioner, United Provinces.

WHEN I commenced my investigation of the outbreak of Relapsing Fever prevailing in the Meerut Division I had not seen the "précis" of Nicolle's experiments with Algerian Relapsing Fever. I therefore based my work which began on the 25th December 1912 on Captain Mackie's Nasik paper published in November 1908. In consequence I spent a great deal of time carefully dissecting lice and examining each organ separately with special reference to the salivary glands and ovaries. In view of Nicolle's experiments this work was really unnecessary. I examined a total of 663 lice caught on sufferers from the disease and found 26·3 % of them infected with spirochætes. In addition I examined over 100 lice caught in uninfected villages and found none of them infected.

The louse is admitted to be difficult to dissect on account of the extreme toughness of its cuticle. The method I adopted was to lay the insect on its back on a slide, in a minute drop of physiological saline solution. I then carefully tore off the two edges of the abdomen with strong dissecting needles and by gentle traction on the two ends of the body tore through the dorsal and ventral connecting bands of epidermis. By continuing the gentle traction the whole of the abdominal contents were separated entire. The separated organs were placed in watch glasses containing saline. The drop of saline in which dissection was carried out and which now contained an admixture of cœlomic fluid was spread out in a thin film, stained and examined. The separated organs after careful washing, by moving them about in the saline with a dissecting needle, were transferred to a slide and a smear prepared. It is extremely difficult to wash the separated stomach without rupture and escape of the contents and the Malphigian tubules are so delicate and transparent that they are readily lost.

I am indebted to Captain Mackie for the following method of removing the salivary glands:—

The insect is laid on its dorsal surface in a minute drop of saline solution. With a dissecting needle a slight tear is made in the epidermis on either side of the neck. A strong needle is then laid across the thorax on a level with the third pair of legs, care being taken in doing so to gently press the stomach backwards out of the way. The head is now fixed with a second dissecting needle laid flat across it, and firm steady to and fro traction applied. The moment the tissues show signs of yielding the tension must be reduced to a minimum when the two salivary glands will be drawn out by their ducts. They are extremely delicate organs shaped like "wishing bones," and the two legs of each appear to embrace the cornua of the stomach. The diagrams in the *Lancet* of July 11th, 1913, appear to me to be a little misleading in this respect.

It may be noted here that the "piercer" which normally lies retracted into its sack can frequently be made to protrude by laying the louse on its back, fixing the body with one needle and applying gentle forward pressure about half-way back on the under-surface of the head. In infected lice spirochætes are not found in the salivary glands, ovaries, testicles or Malphigian tubules, nor in eggs dissected out of the body of the louse, nor in eggs laid by lice which subsequent dissection has shown to be swarming with spirochætes.

In infected lice spirochætes are only found in the stomach and cœlomic fluid. As regards the stomach, Nicolle has found the stomach contents uninfective when inoculated into monkeys. I can only say that, after most careful washing of the exterior of the stomach after removal from the body of the louse, I still found spirochætes when the contents were emptied on to a slide and a smear prepared. On three occasions, moreover, I found spirochætes in smears prepared from fæces passed by infected lice while lying in a drop of saline on a slide.

I failed to keep lice alive under artificial conditions, and failed to infect an animal with relapsing fever. For this reason I could only obtain infected lice from patients. It follows that I had no data as to when the lice examined became infected. One could tell by the state of the stomach whether they had fed recently or not, but owing to the custom common among the low castes among whom the disease was epidemic, of several members of the same family sleeping under one quilt, one could not even be certain that the lice caught on a patient had actually fed on him.

I attempted to keep lice alive by placing them twice daily under a rag laid on the shaved abdomen of a monkey, which was held lying on its back. Many lice refused to feed at all, the mortality was always high and many died with full stomachs. The blood of the monkey took much longer to digest than human blood. If the stomach contents of a louse are examined 4 to 6 hours after it has fed on human blood whole red blood corpuscles are not usually found, whereas 12 hours after a feed on monkey's blood a number of unchanged red blood corpuscles will be seen.

Lice in captivity live 5 to 6 days without food, provided they are given plenty of air and a rag to crawl upon. The mortality, however, is always high and not infrequently a whole batch of lice die off in one night.

Nicolle working with laboratory bred lice, found that after an infective feed spirochætes did not appear in the body of the louse earlier than the 8th day. Working with lice caught in their natural surroundings but of whose history previous to capture one had no data, I observed no fact pointing to this. No matter on what day of the fever the lice were caught the percentage found infected was always more or less the same.

I dissected batches of lice which had been removed from patients and kept without food for periods varying from one to six days, and found the percentage shewing spirochætes always much the same, though one rarely found those that had been starved 5 or 6 days, to shew spirochætes in enormous numbers or in tangled masses.

The percentage found infected in different cases and in different villages varied greatly. For instance, out of 24 lice caught in Mulpurah village, Muzaffarnagar District, only 3 or 12% were found to contain spirochætes, whereas out of 63 caught in Basera village, in same district, 36 or 57% were infected. In both cases the lice were collected on the 4th day of the attack. In about half the total number of lice found infected spirochætes were scarce; not infrequently only 2 or 3 were found after a careful examination of a slide prepared from the cœlomic fluid. In the great majority of the remainder spirochætes were in enormous numbers, occasionally little else being visible in a film of cœlomic fluid than tangled masses of spirochætes.

Nicolle found that after the re-appearance of spirochætes in the lice they persisted up to the 19th day. I have found infected lice on convalescents of 6 days but not on convalescents of 10 and 14 days. It is not always easy to catch lice on convalescents as they amuse themselves while their strength is returning, killing off the lice which have so multiplied during the illness as to cause great discomfort. On one occasion I caught 45 on a woman who had been convalescent 14 days and found none of them infected.

Animal Experiments.

I attempted to convey the disease to animals in the following ways:—

1. Highly infected lice were placed daily on the shaved abdomen of a monkey under a rag and allowed to feed. This was done daily on the same monkey for a whole month. Sometimes the lice were applied twice a day, and sometimes only once. Usually a dozen were applied at one time. Different lice were used each day and batches that had been removed from patients one day, two days, three days, four days, and five days were used. Those that had starved five days were as a rule too feeble to bite. After feeding the lice were dissected and examined to make sure that they were infected.

2. The droppings of 20 to 25 infected lice passed naturally into a drop of saline solution were well-rubbed into the excoriated abdomen of a second monkey. This experiment was repeated 5 times.

3. The cœlomic fluid of infected lice mixed with saline solution was inoculated 4 times at intervals of a week into a young rat.

4. Cœlomic fluid of infected lice mixed with saline was inoculated 3 times into a chicken at intervals of a week.

At each repetition of experiments 3 and 4 a drop of the fluid was examined for spirochætes. On one occasion they were found to have lost their motility.

It did not occur to me to try crushing lice directly into the skin of an animal. Inoculation of cœlomic fluid mixed with saline solution might be expected to have the same effect. I found, however, that when the cœlomic fluid was mixed with physiological saline solution that the spirochætes, which at first are very active, became rather sluggish in 8 to 10 minutes, and totally lost their motility in under quarter of an hour. It is conceivable that the saline solution had some prejudicial effect on the vitality of the organism.

The rat of experiment 3 was sick on the 4th day after one of the inoculations, but its blood did not contain spirochætes and it was perfectly well next day.

In the body of the louse spirochætes have the same appearance as in the human blood except that the spirals are much more regular. They stain much less clearly. Throughout the investigation I used either Leishman's stain or Geimsa. The latter gave far the better results. In many films a small number of spirochætes are found in which there are distinct vacuoles. In others there is an appearance of thickening occasionally at the middle but more usually $1\frac{1}{2}$ spirals from one end. Sometimes, instead of a thickening there is a minute darker stained portion like a granule. It is probable that these appearances are produced by the action of the stains used on the cytoplasm and that they are not developmental changes. Nicolle has produced experimental evidence of the transmission of Algerian relapsing fever by lice, and all the facts connected with the incidence and spread of the disease in the Meerut Division point to its transmission by the same insect.

1. Seasonal prevalence :—

The disease was widely spread in the cold weather of 1911-12. It commenced to die down in the month of April. I was at that time closely watching the spread of the epidemic, and know of no village freshly infected in the second-half of March. In December 1912, the disease was again discovered in epidemic form in the north of Bulandshahr District, and almost simultaneously in Muzaffarnagar. In both districts it had been present in the affected villages for some weeks before discovery.

The earliest authentic cases that came under my notice were in the latter half of September. In certain chamar families in different villages cases of sickness and death had occurred at intervals from September onwards. At the time of my visit to these villages in December relapsing fever was prevalent in these same families. Careful enquiry proved that the earlier cases were of an exactly similar type of fever.

From the examination of chowkidars' death registers and enquiry into the cause of death of certain young adults returned as due to fever, there would appear to be little doubt that the disease also occurs during the hot months but usually only as isolated cases. As the weather gets colder blankets and cotton quilts in which lice thrive and multiply are brought into use, and the disease then spreads and reaches its maximum intensity in the early months of the year.

2. Castes affected :—

Its great prevalence amongst the low and dirty castes as compared with the almost complete immunity of the better classes to the disease in its epidemic form, is strongly in favour of its transmission by lice. All castes may suffer but the vast majority of cases occur among chamars, weavers, and low bred Musulmans. I have seen only isolated cases among the upper classes, but it is significant that on one occasion I found four cases in the household of a well-to-do Jain. Among the upper classes the sufferer is usually a child who probably became infected with lice while at play in the village lanes. In infected households lice can always be found. In highly infected families they are in great abundance and the severity of the infection of a household or village is in direct proportion to the prevalence of lice.

3. The way in which the disease is confined to families is most marked. One will find all the families in the houses surrounding a certain courtyard infected, while the dwellers in a neighbouring courtyard, separated only by a partition wall, will be entirely free.

4. One can almost always trace the source of infection of a village. The usual history is that a certain chamar went on a visit of a few days' duration to the house of a chamar in another village where there had been cases of fever. On his return either he, or a member of his family, went sick and subsequently the disease spread. Not infrequently the first case in a village is the chowkidar or a member of his family.

5. A very strong point in favour of the transmission by lice is that in infected villages there is no other biting insect sufficiently common to account for the great prevalence of the disease. Bugs are practically non-existent in villagers' beds. I have on many occasions carefully examined all the beds in an infected household and failed to find a single bug. Probably the reason is that

the beds are daily out in the sun and are used as chairs in the courtyard where the men sit and gossip with visitors.

Tics are fairly common, but although I have often looked for them I have never found one that had recently sucked blood in an infected household.

A species of spider is very common in the beds, but there is no evidence that it ever bites man, though it is said to cause intense local irritation of the skin if crushed.

I examined a number of tics and spiders for spirochætes with negative results.

6. In the houses of the low and poorer castes there is rarely enough bedding to go round. It is therefore a common thing to find a sick mother in bed with sick and healthy children all together under one cotton quilt. Lice can therefore pass indiscriminately from sick to healthy. This no doubt accounts for the rapid way the disease may spread through a family.

7. Lice are always to be found in an infected household no matter to what station in life the family belong. On one occasion it came to my knowledge that a certain chamar who with all his family were down with relapsing fever, had been working for a well-to-do Jat family in another village. I looked up this family and found a youth of 18 or 19 years suffering from fever. He had been ill 8 days when I saw him, but though his symptoms were typical of relapsing fever, I did not find spirochætes in the single film of his blood I took. After a careful hunt among his clothes I found, to the disgust of his relations, 5 lice and in three of these spirochætes were found. During the two weeks the village was under my notice, no other member of the family was attacked.

8. An interesting point was that, when one first visited an infected village and suggested that one wanted to collect lice, all denied the possibility of there being any lice at all in their clothes. After a little talk, and when it was seen that there was no intention to propose inoculation one was allowed to look for lice. When nearly 100 had been caught the people evidently began to think there might be something in it, and after a few days one had difficulty in keeping up one's stock of lice. Where this occurred and the village happened to be under my notice for ten days or a fortnight, it was noticeable that no fresh case of fever developed and the disease appeared to be dying out.

Nicolle has shown that Algerian relapsing fever is transmitted by the accidental crushing of the lice during scratching and that the mere bite is innocuous. My experiments bear out the innocuousness of the bites of lice. Besides the failure to infect monkeys by the bites of lice, I was myself bitten on three occasions by infected lice. During the months of February and March I frequently had to work in the open, and the high winds which were so common at that time several times blew the lice off the slide on which they were placed prior to dissection on to my clothes. At first when one remembers the remarkable toughness of the cuticle of the louse one is inclined to doubt the likelihood of their being accidentally crushed during scratching, but there is another possibility. When a chamar catches a louse he kills it by crushing it between the finger nails. The nails of the lower castes are invariably ill-cared for and surrounded by fissures and rag nails There is therefore every chance of spirochætes liberated with the cœlomic fluid gaining access to the man's body. It is a common every-day thing to see low caste natives sitting in the sun outside their huts catching and killing off the lice infecting their clothes in this way. If a louse was accidentally crushed during scratching there is plenty of opportunity for the spirochætes to gain access to the human body by the open sores and excoriation produced by scabies which is an almost universally distributed disease among the lower castes in these provinces.

A point of interest is that the mortality among men is apparently considerably higher than among women. I cannot at present produce accurate figures in support of this opinion, but I was very much struck with the large number of families in which all the deaths had occurred among the adult men. The Civil Surgeon of Meerut has also noticed that in mortality circles in which relapsing fever was prevalent, the death-rate among adult men (15-40 years) was considerably higher than among women during the same period of life. In mortality circles where plague is prevalent the converse is the rule. As far as I observed the disease appeared to be equally common among the two sexes.

The actual mortality varied greatly in different villages. In one village there had been 13 cases with 5 deaths and in another village there had been up to the time of my visit some 22 cases without a single death.

The great majority of the deaths are caused by exhaustion. It is a common belief fostered by hakims that a case of fever must be starved. Frequently even water is withheld. I found that when this prejudice was overcome the sick usually recovered.

Preventive measures :—

It is obvious that there must be a crusade against lice. I think a great deal could be managed through the headmen of villages who are put to considerable personal inconvenience when their village is infected as there is an immediate scarcity of labour. This fact will act as an incentive to them to promote reasonable preventive measures.

Lice are delicate insects. If a blanket or cotton quilt is laid out in the sun the lice almost immediately come out of their hiding places and die in a few hours. They are also very readily drowned, but the ordinary method adopted by a chamar for washing clothes is very ineffectual. The clothes must be thoroughly soaked for some minutes.

The common custom of killing lice by crushing them between the finger nails will have to be discouraged.

Finally there is little doubt that the mortality can be very much reduced if the people can be persuaded to feed their sick. Milk is, of course, the best food, but is not always so readily procurable in villages as one might suppose in the quantity required, but a great deal can be done with thin gruels made of the cereals usually available in villages. It is most important that the friends should be warned not to allow convalescents to eat ordinary food for some days after the fever falls.

As a rule very soon after the crisis the patient becomes ravenously hungry, has an enormous meal of parched gram and chappati, and gets an attack of diarrhœa or dysentery which in his enfeebled condition may be rapidly fatal.

GUINEA-WORM DISEASE IN AN INDIAN VILLAGE.

BY

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GUINEA-WORM disease or "dracontiasis" as no doubt you all know is caused by the presence of the guinea-worm in the tissues beneath the skin. The female worm which is found in this situation measures from two to three feet in length. The worm occasions little inconvenience till a blister develops on the skin near the situation of the head of the worm. When this blister bursts a minute hole may be seen on the exposed raw surface from which protrudes, like a fine thread, the evaginated uterus of the worm. From time to time a milky fluid is discharged from the uterus especially when the affected part is bathed in water. If some of this fluid is collected in water and examined with a lens many actively moving minute young guinea-worms can be seen. These young worms measure about one-twentieth of an inch in length and are scarcely visible to the naked eye.

If the young worms are passed into water which contains small crustaceans called "cyclops," they are soon found within the body cavity of the cyclops. Here the young worms undergo metamorphosis. This is an essential stage in the further development of the guinea-worm. Unless the young worms enter cyclops within three or four days of being discharged from the adult worm found in man, they perish.

It is generally supposed and there is much evidence in favour of this view, that when cyclops containing young worms are swallowed by man in drinking water, the digestive juices of his stomach kill the cyclops but activate the young worms which now escape from the body of the cyclops to enter the body of the man who has swallowed the cyclops.

In man the worm grows gradually, requiring about nine to twelve months to develop from a length of one-twentieth of an inch to a length of two to three feet. At the close of this period of incubation the worm has reached maturity and is in a condition to give forth young worms. A blister as we have already mentioned now forms on the skin and the young are discharged; inflammation and suppuration supervene till the adult worm, which now dies, is removed from the body. The extraction of the worm from its situation beneath the skin is a tedious process which often lasts several weeks, for generally only a small portion of the worm can be withdrawn daily. Pain, fever and inability to move about are associated with this stage of the disease. If the joints become involved in the inflammation permanent deformity often follows.

This brief description of dracontiasis shows that the cause of the disease, the guinea-worm, must pass through two phases of development, one in man and the other in a cyclops. To exterminate this parasite and thus to put an end to the disease it is only necessary either to prevent the young worms (which we have seen were derived from the adult in man) gaining access to water containing cyclops or by taking care that men do not swallow in drinking water living cyclops containing young worms.

Theoretically then, the extermination of this disease seems a remarkably simple problem. There is for example no difficulty in diagnosing the disease, the worm can easily be seen. It is a comparatively simple matter to prevent the young worms gaining access to drinking water for they can live but a short time after they leave the human body unless they enter a cyclops. Even after the worms have found their way into water and have completed their phase of development in cyclops, it is easy to remove the cyclops from the water by merely pouring it through a piece of cloth, for the cyclops are large enough to be visible to the naked eye, and cannot pass through the meshes of ordinary muslin.

In this disease we have no invisible microbe to fight, so that the prevention of it, is in fact the simplest problem that can be presented to the sanitarian; yet the

disease is common in many parts of India. We may therefore well ask the question, why then does this disease still exist in India? Our experience of dracontiasis in a small Indian village which we propose to recount here may perhaps help us to answer this question.

In the month of March this year, the Civil Surgeon of Thana, knowing that we were on the outlook for cases of guinea-worm disease, informed us that he knew of a village in his district where many cases were to be found. He introduced us to Mr. Bhave, a graduate in science, and an influential Indian gentleman, who has his salt works near the infected village. Mr. Bhave is deeply interested in the welfare of this village and offered to help us in the study of this disease in it. We visited the village with him and saw a number of cases of dracontiasis. We explained to him and the villagers the cause and the origin of the disease and made enquiries regarding the village water-supply. We found that in the dry season water was always very scarce in the village, and that the Local Board had endeavoured some years previously to improve the water-supply by constructing a new well. This well we were led to understand on our first visit was the only source from which the villagers obtained water. The well was of the usual standard pattern and was in good condition. Although we found cyclops in the water of the well none of these were infected with the guinea-worm. At our first visit therefore we were unable to find the source of infection in this village.

On a second visit to the village a week or two later, we accidentally discovered a second well which had not been shown to us, or even mentioned, at the time of our first visit. Many villagers were observed to be drawing water from this well; the parapet was broken down and the well had been allowed to fall into a state of disrepair. We learned that the well was the property of the village and that many people obtained their water from it because it was nearer to their houses than the Local Board well. The appearance of the well at once suggested that it was the source of the disease in the village. A person drawing water from it could stand right over the water so that young guinea-worms could easily be discharged into the well. A sample of the water of the well revealed the presence of very many cyclops and subsequently an examination of them at the laboratory showed that of 114 cyclops, forty-four or 38·6% contained young guinea-worms.

On this occasion we showed the cyclops to Mr. Bhave and those villagers who were around the well at the time. We explained and demonstrated to them how the cyclops could be removed from the water by simply pouring it through a piece of cloth. We advised the villagers to repair their well, and as a further precaution against guinea-worm infection to strain their drinking water through a piece of cloth. We took care at the same time to warn them that any measure which they now took to prevent the disease would only bear fruit a year hence for infection preceded the development of the disease by so long an interval.

Meanwhile, Mr. Bhave, realising that the villagers would not on their own part take any steps to repair their well, suggested to them that he might succeed in obtaining the assistance of the Local Board to repair the well. The villagers in a body opposed this suggestion imagining that if the Local Board assisted in repairing their well they would themselves no longer have any right or control over it.

Mr. Bhave then proposed to make a new well and approached one of the village land-owners for a site for it offering a fair sum for the land required. This man had the welfare of the village so little at heart that he refused to accept Mr. Bhave's offer unless he bought the whole of his property at a high price, which was of course out of the question.

Mr. Bhave was thus forced to seek the assistance of the Local Board for he realised that, apart from the difficulty of acquiring a suitable site for the new well, it seemed useless to construct it so long as the old disease-producing well remained open and could be used as a source for obtaining drinking water. He has now offered to supply two pumps for a new well, provided that the Local Board sinks the well, covers it and closes the old well. Although nearly a year has passed since the source of infection was discovered in this village matters have developed no further. A second epidemic season is approaching but the villagers have not, on their own initiative, taken any action. They apparently remain indifferent to the presence of the disease, or perhaps it would be more correct to say that they do not realise their danger.

In this connection it is interesting to give a brief account of the extent to which the disease is present in the village. With the assistance of Mr. Bhave, we made a census of the village and noted how many persons were suffering or had suffered from guinea-worm disease. We found that there were sixty-two inhabited houses in the village with a population of 269 souls, 150 males and 119 females. During the epidemic of dracontiasis in the current year cases occurred in 20 houses among 29 persons, that is, 10·78% of the villagers. So far as we were able to get a history of the disease in past years, we learned that 98 persons of the 269 inhabiting the village had suffered from the disease at one time or another, so that 38·68% of the villagers, or every third person in the village, had been afflicted by the disease. It

is curious to note that the males seem to be more commonly affected by the disease than females, 43% of the total male population had suffered, compared with 26% only of the female population.

In such circumstances it is extraordinary to find so much indifference to the disease. It is true that after our visit and explanation of the cause of the disease, we saw that for a short time a few of the villagers strained the water of the well through a piece of cloth but now, after some months, they have grown weary of using this simple measure to protect themselves from the disease, perhaps because the wells at this season are full of water which they consider is good enough to drink without being strained.

It seems extraordinary that in this village, where water is so scarce that the supply to each house is strictly limited during two or three months of the dry season, this precious commodity is so little prized and protected by the villagers that it is a common practice for men and boys to swim and bathe in the wells. On one or two occasions, during our visits to this village, we saw boys either bathing or playing in the water of the wells when there was scarcely enough of it in either well to fill a moderate sized bath tub. Yet this was the only source from which the villagers derived their drinking water and they were quite content to use it.

Our experience in this village showed that, although we were at some pains to approach the villagers through their own educated leaders, we found them suspicious of our motives. For a time they concealed from us the existence of the dilapidated village well and they refused to accept assistance in repairing it lest they might at the same time be deprived of their rights over it. Although care was taken to explain and demonstrate to the villagers the nature and source of infection in the village they regarded our story as a fairy tale, and could not realise its importance for them. While they were for a time impressed by the demonstration of the cyclops in the well water their patience in removing these creatures from it was soon exhausted. They were indifferent as to whether they drank the purer water of the District Board well, or the more polluted village well; they seemed to prefer the latter because it was nearer to their homes. It mattered little to them whether their drinking water had been used for bathing purposes. They failed to co-operate among themselves or with their leaders in an endeavour to repair their well and were even unwilling to accept assistance when it was offered to them.

In attempting to find an answer to the question—" why does dracontiasis still exist in India ?—our experience in the little village of Sarsola shows that the great causes for the persistence of this disease in this country are the suspicion, the ignorance, the indifference and the lack of the spirit of co-operation which unfortunately, at the present time, are the predominant characteristics of its people. It is not the scientific or physical but the social difficulties which must be overcome before dracontiasis can be banished from the country.

We trust that the proposal to sink a new well in this village will be carried through; that this well will be covered over so as to prevent persons entering it; that pumps will be used to draw up the water; and that the old infected well will be closed. There can be no doubt about the benefit which the successful carrying out of this simple scheme will confer on this village, not only as regards the prevalence of guinea-worm disease, but of cholera also, for, as might have been supposed, this disease frequently occurs in this village. Demonstrations of this kind, we think, are the only means by which suspicion, ignorance, indifference and the lack of co-operation,—these great barriers to sanitary progress in this country,—can be overcome.

THE DISTRIBUTION OF GUINEA-WORM IN INDIA.

BY

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DRACONTIASIS or guinea-worm disease is generally said to be widely distributed over the Indian Peninsula. No reliable data, however, are available to determine with any degree of accuracy the extent to which the disease is prevalent in the different parts of the country.

The number of cases of guinea-worm treated in the various hospitals and dispensaries in the Bombay Presidency are not shown in the annual hospital returns. In accordance with orders issued by the Surgeon-General at our suggestion the number of cases of guinea-worm disease which were treated at certain of the hospitals and dispensaries of the Bombay Presidency during the years 1907-1911, were compiled from the registers kept in the dispensaries. These figures, however, gave a very inadequate idea of the extent to which this disease exists in the districts. The people seem to be so familiar with the disease and realise that so little can be done for them at these dispensaries that they seldom avail themselves of the treatment. In this connection may be mentioned the case of the Panch-Mahals district in the Bombay Presidency where dracontiasis is very common. In that district, during March 1912 when famine was prevalent, nearly 2,000 cases of guinea-worm disease came to the notice of the Collector because the villagers were then under special supervision. This figure probably represents the maximum annual incidence of the disease among the people of this district, for, during the month of March, when the figures were obtained the disease is most common. Yet the returns compiled for the previous five years from all the five dispensaries in the Panch-Mahals district, showed an average of only 80 cases treated per annum for each dispensary in that district.

The hospital and dispensary statistics, unsatisfactory though they are, nevertheless yield a more correct estimate of the prevalence of this disease in the various parts of India than any other returns at present available. Bearing in mind the facts that this disease is perhaps one of the most easily preventable of all diseases, that it sometimes is so prevalent among the inhabitants of certain villages as to seriously interfere with their harvesting operations, and that, although the disease is very rarely fatal, yet it causes much suffering and occasionally permanent deformity, it seems desirable that more accurate information as to the exact distribution and extent of this disease should be available than at present exists. This perhaps might be accomplished by recording the number of cases treated in the hospitals and dispensaries in a separate column in the official returns.

The present paper is an attempt to show the distribution of the disease in India so far as it is possible from the statistical data available. The only official figures dealing with guinea-worm disease are those recorded in the Annual Reports of the Sanitary Commissioner with the Government of India, in connection with the statistics pertaining to the Native Troops and Prisoners; even in these reports the figures for the troops have been discontinued since 1908.

For the purpose of collecting medical statistics, and also for the tabulation of meteorological data for the medical department, the whole of India has been divided into 11 geographical groups which are so arranged as to "represent areas which are fairly homogeneous so far as the chief prevailing diseases and climatic conditions are concerned." These groups are :—

I. Burma Coast and Bay Islands.
II. Burma Inland.
III. Assam.
IV. Bengal and Orissa.
V. Gangetic Plain and Chutia Nagpur.
VI. Upper Sub-Himalaya.
VII. North-West Frontier, Indus Valley and North-Western Rajputana.
VIII. South-Eastern Rajputana, Central India and Gujarat.

IX. Deccan.
X. Western Coast.
XI. Southern India.

These groups have been divided into smaller sub-divisions. The hill stations, which in the Sanitary Commissioner's reports are all considered under one special group, have been shown in the accompanying tables under the sub-divisions in which they are situated.

The tables have been prepared from data contained in the Annual Reports of the Sanitary Commissioner with the Government of India. The figures given against each sub-division in Table A, column (4), record the summed figures of the average annual strength of the Native Troops for each of the twelve years, *viz.*, 1896 to 1907. In column (5) the total number of cases of guinea-worm disease admitted to hospital during that period are recorded. In the last column the ratio of incidence per 1,000 per annum is given. The Table B gives figures similarly compiled from among the prisoners in the jails in India, and concerns exactly the same periods of 12 years as in Table A.

The value of the figures given in the tables, as furnishing a guide to the intensity and distribution of the disease in India, is greatly lessened on account of the following sources of error.

In the first place, the population which is taken into consideration is a very small fraction of the total population, and moreover deals with selected groups of persons. This source of error is especially pronounced in the case of Table A, where the selected population, regimental sepoys, live under better sanitary conditions and surroundings than the ordinary villagers. Moreover, the sepoys stationed in a locality are generally the residents of quite a different part of the country and infection may have been acquired by them when on leave in their own native villages. Secondly, as a source of error, we have to bear in mind the long incubation period of the disease which extends, be it remembered, from 9 months to a year. A regiment or a company, which may have contracted infection in a station where the guinea-worm is prevalent, may be moved to another station where the disease is unknown and may there develop the disease, the record of the sick being returned from this place. In this way a place may be free from the disease although the table may show that some cases have occurred in it.

Table A, which deals with Native Troops, shows that the sub-division in which dracontiasis is most prevalent is VIII-B, *i.e.*, South-Eastern Rajputana and Central India. Here the disease prevails amongst the troops to the extent of 18 cases per mille of strength per annum.

The next sub-division in which the disease is also largely prevalent is VIII-A, *viz.*, Gujarat, with a ratio of 13·40 admissions per mille.

The other sub-divisions where the disease prevails are :—

IX-B. Deccan proper; ratio 7·10 per mille.
X. Western Coast; 5·72 per mille.
V-B. Gangetic Plain; 5·5 per mille.
VI-A. Upper Sub-Himalaya; 5·22 per mille.
VII-C. Sind; 5·12 per mille.

While these sub-divisions show a high prevalence, all the hill stations appear to be free from guinea-worm disease with the exception of those in connection with VII-B, the North-West Frontier Province. Inland Burma also appears to be free from the disease.

The Table B which deals with the populations found in the jails and which covers exactly the same period as the Table A, probably more accurately represents the prevalence of the disease in the various parts of India. Prisoners generally come from places where, until the day of admission, they had been living under the usual conditions prevailing in their villages. Moreover, the prisoners are usually the residents of the sub-divisions in which the jails are located. Some of the fallacies therefore which are likely to affect the figures in Table A are less pronounced in Table B.

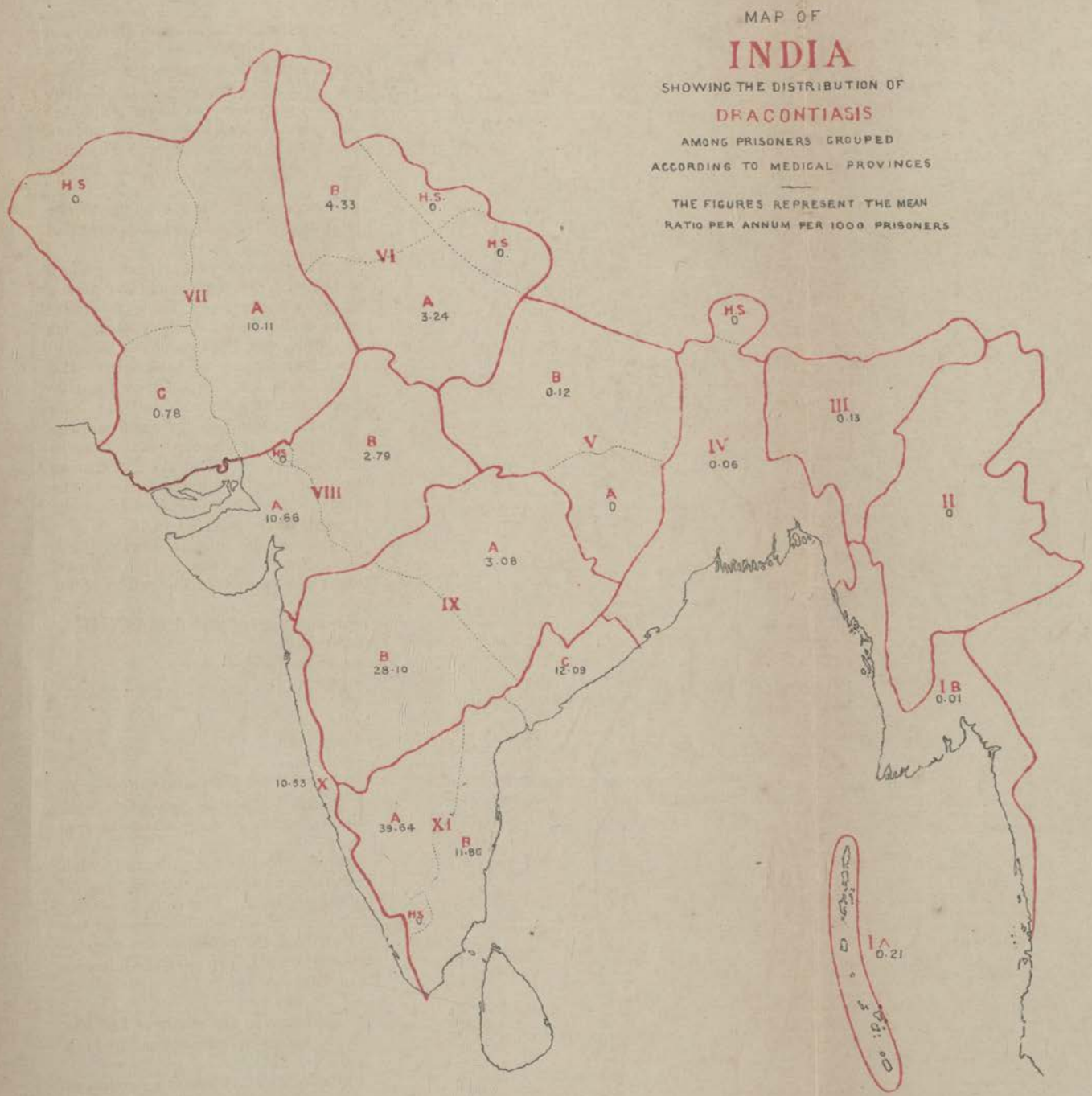
From this table it appears that the most afflicted area in the whole of India is XI-A, the western portion of the Madras Presidency with the extraordinarily high ratio of 39·64 per mille.

The sub-division which in intensity of infection follows the western portion of the Madras Presidency is IX-B, the Deccan proper, with a very high ratio of 28·10 per mille.

The other localities where dracontiasis is common are (see map) :—

XI-C. The Northern Circars; ratio 12·09 per mille.
XI-B. Madras and Carnatic; 11·86 per mille.
VIII-A. Gujarat and Kathiawar; 10·66 per mille.
X. The Western Coast; 10·53 per mille.
VII-A. The Indus Valley and N.-W. Rajputana, 10·11 per mille.

The Hill Stations, Burma (Inland and Coast) and the Andamans, are all free from the disease.


MAP OF
INDIA
SHOWING THE DISTRIBUTION OF
DRACONTIASIS
AMONG PRISONERS GROUPED
ACCORDING TO MEDICAL PROVINCES
THE FIGURES REPRESENT THE MEAN
RATIO PER ANNUM PER 1000 PRISONERS
H S 0
B 4·33
H.S. 0.
H S 0.
VI
A 3·24
VII
A 10·11
C 0·78
H S 0
B 2·79
VIII
A 10·66
B 0·12
V
A 0
H S 0
IV 0·06
III 0·13
II 0
A 3·08
IX
B 28·10
C 12·09
I B 0·01
10·53
X
A 39·64
XI
B 11·80
H S
I A 0·21

Comparing Tables A & B with one another, the following noticeable differences are observed :—

Whereas the sub-division VIII-B, South-Eastern Rajputana and Central India, shows a high ratio of 18·00 among the Indian Troops, a low ratio of only 2·79 is recorded among the prisoners.

Although dracontiasis does not occur among the prisoners in the Gangetic Plain and Chutia Nagpur, group V, the sepoys stationed in the same area appear to suffer a good deal from the disease.

On the other hand, while guinea-worm disease is very prevalent among the prisoners in the whole of Southern India (group XI), it is very rare among the sepoys stationed in the same area.

These discrepancies are probably due to some of the sources of error in compiling the statistics already mentioned. Thus the high ratio among the sepoys stationed in a locality showing a low ratio among the prisoners may perhaps be explained on the ground that the sepoys contracted infection in their native villages while on leave or before their transfer to the stations in which they were reported to be sick with the disease. Again a low ratio among the troops in the localities where the disease is prevalent among the prisoners may be attributed to the superior sanitary surroundings in which the sepoys dwell.

The tables, however, serve to emphasise the wide distribution of the disease in India, and the purpose of this paper will be served if it draws attention to the fact that dracontiasis, which is probably the most easily preventable of all tropical diseases, occurs in some parts of India to such an extent that nearly 40 per mille of the jail population in certain areas are affected by this crippling disease.

TABLE A.

Group.	Sub-division.	Locality.	Total of average annual strength of Indian Troops from 1896 to 1907.	Total admissions for guinea-worm disease from 1896 to 1907.	Ratio per 1,000 of strength per annum.	Remarks.
I	A.	Andamans	3,439	6	1·77	
	B.	Burma Coast ..	14,449	21	1·45	
II	—	Burma Inland ..	49,038	23	0·46	
	H. S.	Hill Stations ..	8,912	5	0·56	
III	—	Assam	16,005	74	4·53	
	H. S.	Hill Stations ..	13,606	5	0·36	
IV	—	Bengal and Orissa ..	30,428	87	2·8	
	H. S.	Hill Stations ..	3,014	3	0·99	
V	A.	Chutia Nagpur ..	4,246	20	4·71	
	B.	Gangetic Plain ..	71,030	403	5·51	
VI	A.	Upper Sub-Himalayas (Delhi)	79,673	416	5·22	
	H. S.	Hill Stations ..	33,940	16	0·47	
	B.	Upper Sub-Himalayas (Lahore)	116,228	352	3·02	
	H. S.	Hill Stations ..	32,249	13	0·40	
VII	A.	Indus Valley and N.-W. Rajputana ..	173,135	629	3·63	
	B.	North-West Frontier ..	9,399	35	3·72	
	H. S.	Hill Stations ..	145,653	603	4·13	
	C.	Sind	20,094	103	5·12	
VIII	A.	Gujarat	34,456	462	13·40	
	B.	S.-E. Rajputana and Central India ..	111,498	2,008	18·00	
	H. S.	Hill Stations ..	995	2	2·01	
IX	A.	Deccan (Central Provinces)	37,802	155	4·10	
	B.	Deccan Proper ..	169,843	1,206	7·10	
X	—	Western Coast ..	27,253	156	5·72	
XI	A.	Southern India (Bangalore and W. Madras) ..	46,902	169	3·60	
	H. S.	Hill Stations ..	4,791	1	0·20	
	B.	Southern India (Carnatic and Madras) ..	26,850	45	1·60	
	C.	Southern India (Northern Circars)	6,764	18	2·66	

TABLE B.

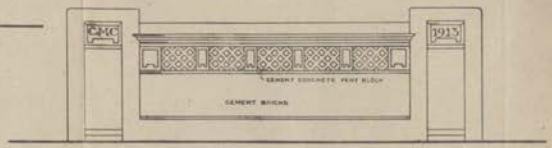
Group.	Sub-division.	Locality.	Total average annual strength of prisoners from 1896 to 1907.	Total admissions for guinea-worm disease from 1896 to 1907.	Ratio per 1,000 of strength per annum.	Remarks.
	A.	Andamans	150,329	33	0·21	
I	B.	Burma Coast ..	102,211	2	·01	
	—	Burma Inland ..	49,497	....	....	
II	H. S.	Hill Stations ..	....	....	....	
	—	Assam ..	15,385	2	0·13	
III	H. S.	Hill Stations ..	517	....	....	
	—	Bengal and Orissa ..	142,036	9	0·06	
IV	H. S.	Hill Stations ..	1,119	....	....	
	A.	Chutia Nagpur ..	628	....	....	
V	B.	Gangetic Plain ..	287,617	36	0·12	
	A.	Upper Sub-Himalayas (Delhi)	93,403	303	3·24	
VI	H. S.	Hill Stations ..	1,025	....	....	
	B.	Upper Sub-Himalayas (Lahore)	69,184	300	4·33	
	H. S.	Hill Stations ..	749	....	....	
	A.	Indus Valley and N.-W. Rajputana ..	69,374	702	10·11	
VII	H. S.	Hill Stations ..	....	....	....	
	C.	Sind	24,125	19	0·78	
	A.	Gujarat	14,722	157	10·66	
	B.	S. E. Rajputana and Central India ..	44,430	124	2·79	
VIII	H. S.	Hill Stations ..	....	....	....	
	A.	Deccan (Central Provinces)	51,924	150	3·08	
IX	B.	Deccan Proper ..	56,193	1,579	28·10	
X	%	Western Coast ..	2,290	11	10·53	
	A.	Southern India (Bangalore & W. Madras) ..	24,520	972	39·64	
	H. S.	Hill Stations ..	....	....	....	
	B.	Southern India (Carnatic and Madras) ..	58,143	690	11·86	
	C.	Southern India (Northern Circars)	17,830	231	12·09	

COLOMBO MUNICIPAL COUNCIL

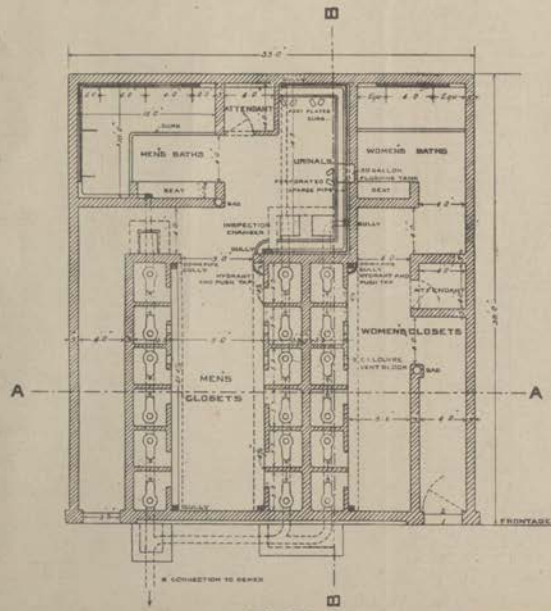
CITY SANITATION ENGINEERS DEPT

PUBLIC LATRINE TYPE PLAN A

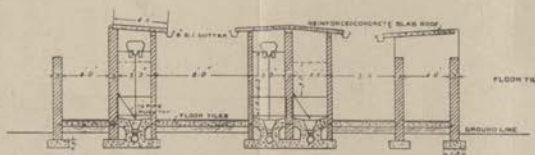
SCALE ½ INCH = 1 FOOT



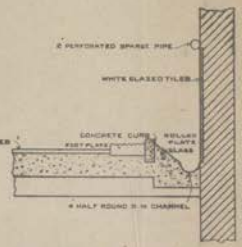
FRONT ELEVATION



PLAN

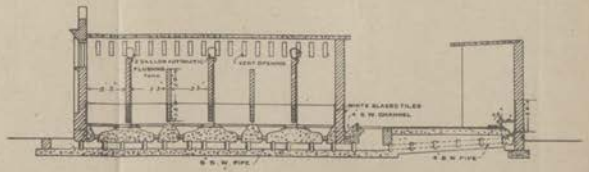


SECTION A A



DETAIL OF URINAL

SCALE 1 IN = 2 FOOT



SECTION B.B

O. M. A. Aluwihare
12 - 11 - 13

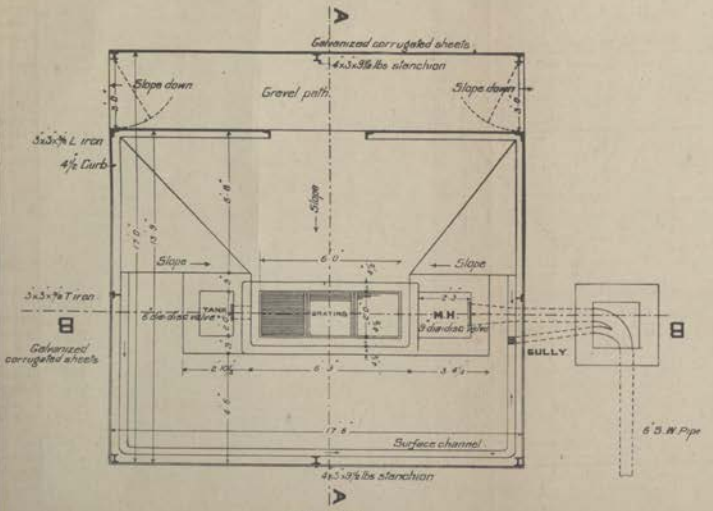
City Sanitation Engineer
12 - 11 - 13

— COLOMBO MUNICIPAL COUNCIL —

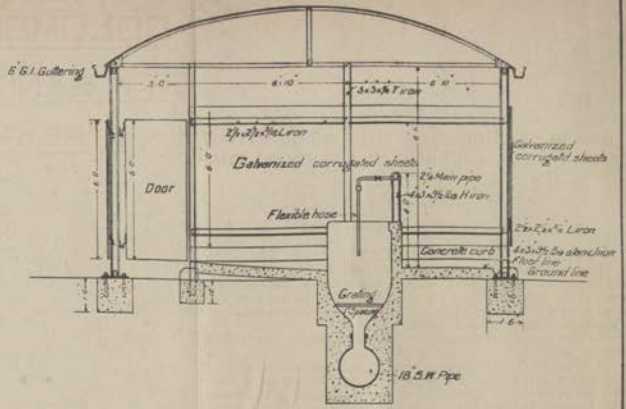
— CITY SANITATION ENGINEER'S DEPT —

— TYPE PLAN OF TIPPING DEPÔT —

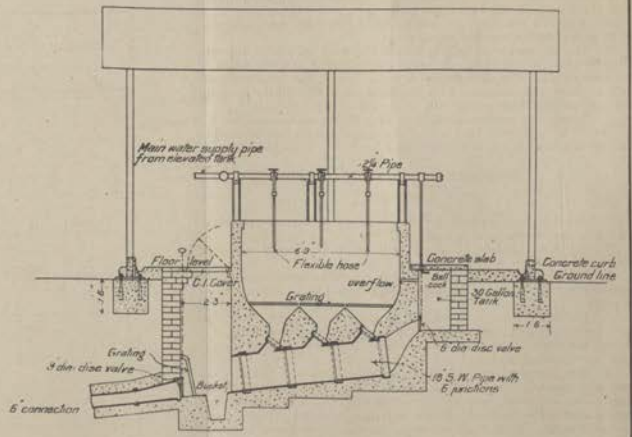
— SCALE ¼ INCH – 1 FOOT —



— PLAN —



— SECTION. A.A. —



— SECTION. B.B. —

D.W.A. Wickramasinghe
3 · 11 · 43

C. L. Cox
City Sanitation Engineer
3.11.43

DESCRIPTION OF TYPE DESIGNS RELATING TO WATER CARRIAGE PUBLIC LATRINES, COLOMBO.

BY

MR. C. L. COX,

City Sanitation Engineer, Colombo.

TYPE DESIGNS.

THE plan illustrates a maximum size standard latrine providing 12 closets with urinals and bathing-places for men and 6 closets and bathing-places for women. The intermediate size provides 8 closets for men and 4 for women, with urinal and bathing-places, and the minimum size 4 closets and urinal for men and 2 closets for women, without bathing-places.

2. The general arrangement is varied to suit the site, but in detail all the buildings are similar.

3. The closets are arranged in series of six. The pans are of the Hindustan front flush type and discharge direct into a 6-inch diameter glazed stoneware pipe drain laid horizontally. Two inches of water is retained in the invert of each drain by means of a weir at the outlet end.

4. Each pair of pans is flushed by a 2-gallon automatic flushing cistern fixed over the divisional walls, and the horizontal drains are additionally flushed by the waste water from the bathing-places or, where these are not provided, by means of 10-gallon automatic flushing tanks. Ablution water is supplied to each closet by a $\frac{1}{2}''$ spring push tap fixed opposite the user.

5. Water for the bathing-places is supplied by overhead showers controlled by spring push taps on the wall opposite.

6. The latrines are all built in cement and sand brick with concrete ventilating blocks and special red tile floors and reinforced concrete closet divisions and roofing slabs. (The closets only are roofed over). The urinal backs and closet stalls are lined with white glazed tile to a height of 2′ 6″. All the concrete blocks and slabs and the flushing pipes and connections are standardised.

7. Twenty-one of these latrines providing 224 closets for men and 97 closets for women, have recently been erected throughout the drained areas of the City and they are used, in one way or the other, by 75,000 to 80,000 persons daily.

NIGHT-SOIL TIPPING DEPOT, COLOMBO.

TYPE DESIGN.

IT has not yet been decided whether, as a temporary measure, the use of tipping depôts shall become general in the City.

2. The plan illustrates the depôt proposed to be adopted and with slight modification is similar to the one already in use.

3. The existing depôt was introduced to relapce various storage depôts where night-soil was stored during the day awaiting transport to the trenching-ground at night.

4. The depôt serves a crowded area from hich night-soil is collected by day, transported by manual labour in large size buckets and tipped at once through the depôt into the sewers. 270 buckets representing a population of about 8,000 are disposed of daily.

5. The general adoption of the tipping depôt system in Colombo, even as a temporary measure, is complicated by the fact that coir dust is supplied by the Municipality and freely used for covering the night-soil in the house buckets. In large quantities this material would be objectionable at the pumping stations and treatment works. If the depôt system is extended it is proposed to overcome the difficulty by substituting a liquid disinfectant for coir dust.

NOTE ON NIGHT-SOIL DEPÔTS.

BY

MR. J. W. MADELEY, M.A., M.I.C.E.,

Special Engineer, Corporation of Madras.

Need for night-soil depôts.

1. THE conservancy of night-soil in cities is an insanitary, objectionable and out-of-date method of removing fæces. The smell produced by a string of night-soil carts passing through the streets is extremely nauseating. Moreover, the trenching-grounds have to be removed so far from most of the densely inhabited areas, that the expense of this method of dealing with night-soil is very great. In Madras the Health Officer estimates it to be Rs. 1,30,000 per annum. For these reasons it is highly desirable to do away with the trenching-grounds. Excreta should, of course be flushed into a sewer within a few seconds of deposition ; it then travels forward aided and enveloped by an allotted amount of water. A good many years must pass, however, before night-soil conservancy can be abolished in Madras. In the meantime, in order to dispense with the present objectionable and expensive method of dealing with night-soil depôts, where the night-soil may be introduced into the sewers are being established.

Excreta collected in a cart should never be put directly into a sewer because it is not sufficiently liquid to flow easily; in Madras there is a strong additional reason, for the scavenger, when collecting, picks up with the excreta quantities of sand and silt, mingled with fragments of brick and mortar, sticks, stones, leaf plates, ashes, tin cans, and other refuse, that should on no account be allowed to enter a sewer.

*DRAWING NO. I.—Shows a depôt designed specially to deal with Madras night-soil. The conservancy cart is backed up to one of the two receiving places and is there tipped : the excreta falls directly on to a cast-iron grating, the surface of which is about 2 feet below ground-level in order to prevent splashing, an abundant stream of water from a pendant flexible jet-piece is directed into the cart, which is sluiced clean : the cart then moves away and the jet is directed on to the deposited excreta, quickly forcing it down through the $1\frac{1}{2}$ inch spaces between the bars. In this way, the excreta is at once separated from all large refuse such as sticks, cans and leaf plates. This refuse is left on the bars, from which it can be removed easily by a proper rake, adapted to draw the rubbish up the masonry slope on to the floor. It is then lifted into a cart and sent to the destructor ; or a small single cell destructor could be easily attached to a depôt, if desired. The excreta, as it is driven by the water jet through the grating, becomes broken up, mingled up with water, and reduced to a fairly thin consistency. In this state it falls into a smooth cemented shoot, which promptly delivers it, through the division wall, into what may be called the " flushing invert." This invert is a wide channel, having a narrow rounded bottom sloping quickly towards the inlet to the sewer. The lower portion of the invert is occupied by a series of narrow cast-iron gratings, of cross bars spaced $\frac{3}{4}$ of an inch apart ; the cemented invert is continued at a lower level, beneath this long narrow grating. When a considerable quantity of sluiced and screened night-soil has collected in the invert trough, a self-closing valve is held open to give direct access into a sewer, and at the same time the flushing chamber is brought into action at the top end of the trough. The whole mass of excreta, in a liquid state, then pours into the sewer and is carried away. All refuse that escaped the large bars in the receiving places will now be caught on the long narrow grating in the bottom of the cemented trough, from which it can be readily drawn up by rake on to the floor of the depôt.

A pit to intercept sand and silt is also provided, so that nothing but water and night-soil may enter the sewer. The silt is lifted from the silt-pit by means of the silt raises described in the writer's paper on " the exclusion of storm water and silt from sewerage systems." The carting floors are of well dressed and grouted stone pitching which is sloped to the trough to facilitate cleansing ; the mixing floor will be of concrete, similarly sloped to assist washing. All corners are rounded, and every

* Not reproduced, shown as lantern slide.

precaution has been taken in the design to ensure sanitary conditions, and to reduce smell, as much as possible, in the night-soil depôts. A cast-iron curb imbedded in concrete, is provided for each receiving place, in order to prevent damage from cart wheels. The jets are controlled by small simple hand wheel valves. The supply pipes to jets and flushing tank are arranged so that no fouling is likely to occur to the water mains, under the existing conditions of intermittent supply; where required an overhead storage tank is provided.

2. One such night-soil depôt dealing with a population of about 167,000 has been erected and has been working for two years. It is so successful that the Health Officer has asked that others should be installed so as to govern the whole of Madras City.

Three or four night-soil depôts properly arranged would ensure that no portion of the closely built-up areas should be more than a mile and a half from a depôt.

3. From a statement supplied by the Health Officer based on the actual cost of working, it is estimated that the saving in the cost of the disposal of night-soil by the adoption of pail depôts will be some Rs. 25,000 to Rs. 30,000 per annum. The cost of the disposal of night-soil in the city of Madras is estimated by the Health Officer at Rs. 1,30,039. Thus the saving effected is about 25 per cent. When night-soil is wholly disposed of by the water carriage system, this additional revenue of 1·3 lakhs of rupees will accrue to the Corporation.

NOTE ON FLUSH-OUT LATRINES USED IN THE CITY OF MADRAS.

BY

MR. J. W. MADELEY, M.A., M.I.C.E.

Special Engineer, Corporation of Madras.

THE following description relates to the two types of latrines which have been designed by the writer and have now been adopted as standard types for the City of Madras.

Latrine type B.

1. In the superior type B there is a separate compartment with either a European W. C. or an Indian squatting basin provided with siphon trap and separate flushing cistern. This type of latrine will follow very much the lines of European latrines. It is illustrated on Plate I.* It is recommended as clean and sanitary, and suitable for educated and intelligent people who will give it the slight amount of attention that is required to keep it in good order.

Latrine type A.

2. A cheaper form of latrine which is used successfully in Madras, both for public latrines and for factories and large offices, is of an automatic flushing type, the flush being provided either by a tipping bucket or by a siphonic flushing cistern. Separate compartments are provided because it has been concluded that Indians appreciate privacy in these matters as much as Europeans and it is important to encourage a sense of decency and a desire for good sanitation especially among the class that use public latrines. The arrangement of this type is shown on Plate No. II,* which is self-explanatory. The latrines are divided into compartments, all opening on to a common passage. Separate accommodation is provided for each sex.

As the result of experiment, the sizes of the compartments have been fixed at 2 feet 6 inches square. The positions for taps, foot places, hoppers, and doors have also been determined by experiment. Short automatic swing-to doors of light teak boarding give privacy. The tops of the doors are 4 feet 9 inches high, but the doors themselves are only 3 feet 9 inches deep and 12 inches above the floor. Owing to the limits of the latrine corridor, no one can see too much either over or beneath these doors except by unusual effort. On the other hand, it is easy to ascertain whether a compartment is occupied or not. The user on entering the latrine pulls open a pair of these small doors, which swing to gently behind him, he then finds his feet in position on the only standing room in the compartment. Facing him, but only 12 inches above floor-level is a small automatic water tap. While a person is using the latrine, this tap comfortably supports the right hand, leaving the left hand free to wash with. These washings fall on a narrow trough-like area and cleanse it of urine. The excreta passes into the 6-inch covered pipe channel which passes under each compartment. The pipe is laid dead level, and by means of a small and suitably shaped cement fillet a slight depth of water is maintained in the pipe. This is sufficiently deep to prevent the excreta adhering to the pipe, but is too shallow for splashing to be produced. The user of the latrine having washed, stands up, steps into the passage, and the doors swing to again. The ablution tap closes itself automatically when the hand is taken from it. At first brass taps were used, but recently cheap iron taps have been obtained. In some cases the 6-inch stoneware pipe drain is flushed clean by an automatic siphonic cistern; in other cases, by the waste-water from the drinking fountain and washing place, which, as will be seen from the Plate is in the open air, at one end of the building, but quite outside it. Before entering the flushing cistern, the waste-water is passed through a silt-catcher to free it from silt which may have been used for cleaning pots or brought on to the

* Plates No. I and No. II were shown as lantern slides.

platform by the feet of those using it. From the silt-catcher the clear water passes into a tipping box, which discharges its contents, almost instantaneously, when it is filled up to a pre-determined point; and rights itself again immediately the discharge is completed.

The frequency of tipping, and consequent flushing depends on the rate at which water is wasted at the washing-place. This is generally sufficiently rapid at all hours of the day, but, if at any time more flushing is desirable, it can be secured by turning on one of the public taps for as long as may be necessary. This is done by the attendant who is responsible for the cleanliness of a number of latrines.

WELL HEADS AND THEIR PROTECTION AGAINST POLLUTION.

BY

MR. H. A. GUBBAY, A.M.I.C.E.,

Executive Engineer, Hazaribagh Division.

1. IN order to obtain a wholesome supply of water from a village or other well it is necessary in the first instance to select a site for the well which is free from existent sub-soil pollution. It is equally important to preserve a considerable area round the well in order that the subsoil may not be polluted in the future.

2. A third precaution, one which is not generally observed, is to prevent the well being contaminated by the re-entrance of drippings and washings of water already used. One frequently observes the users of wells, both in the remotest villages and in places having a greater claim to civilisation, bathing and washing their clothes by a well side. At Railway Stations and at melas the users of wells usually perform their ablutions within a very short distance of the wells—unless proper precautions be taken, used and contaminated water is sure to drain back into the well and pollute it. This paper details a few arrangements devised and used in this province to remove the causes of contamination.

3. Plate 1 shows the well head devised by Mr. Disney, Sanitary Engineer to the Government of Bihar and Orissa. This well head provides a raised parapet 3′ 6″ above ground-level and an impervious apron 4′ 6″ wide together with a drain. An attempt has been made to prevent re-entrance of water to the well by bevelling the parapet but in the writer's opinion this provision is insufficient, the sloping portion of the parapet would in the ordinary course of events, be soon demolished.

The other points requiring notice are :—

(*a*) the provision of an impervious drain instead of the pervious brick drain provided;

(*b*) provision against cracking of the impervious apron owing to subsidence of the well shaft after construction.

4. Plate 2 shows the well head in use by the Hazaribagh District Board. The 2 plates on either side effectually prevent the re-entrance of used water from either bathing or the washing of clothes. No provision is made against the entrance of leaves or rain-water into the well.

5. Plate 3 shows a well head recently designed by Major A. Stevens, I.M.S., Civil Surgeon, Gaya.

This well is worked with a bucket or buckets suspended from a *lath kanta* in the usual manner of the country. There are two parapets—the outer one being higher than the inner one and closed in at the top with a sheet steel diaphragm with a slit in it to provide for the passage of rope or chains from which the bucket or buckets is suspended—

This slit is lipped—so

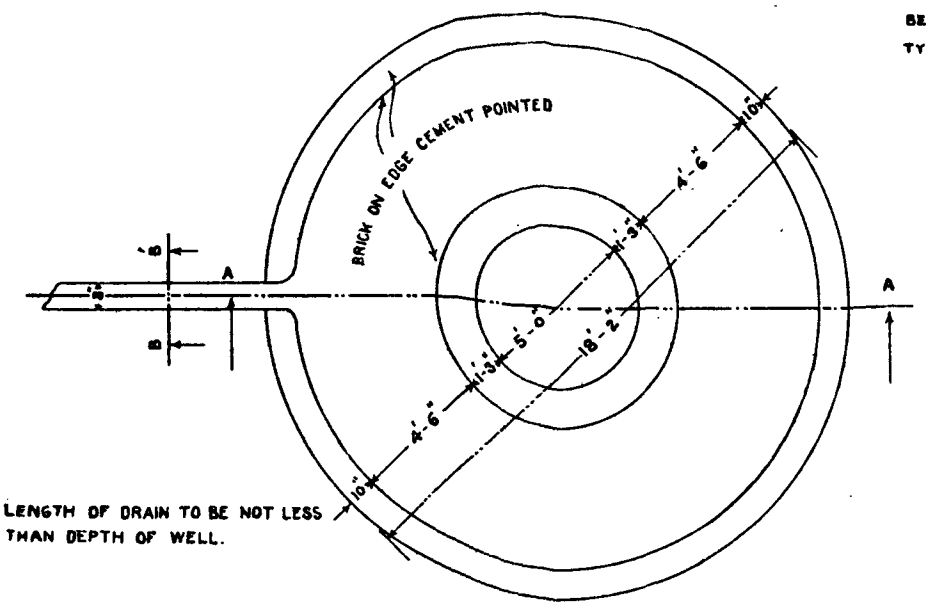
The diaphragm is slightly conical so as to allow rain-water and splashings to run out through weep holes C. C. C.

The water drawer places his vessel under the pipes D. D. on a small platform provided for the purpose and then ascends by means of the steps and resting his feet on the joists provided for the purpose lowers his bucket into the well and after having filled it draws it upwards till he gets it above the level of the shelf E.

PLAN FOR A WELL HEAD

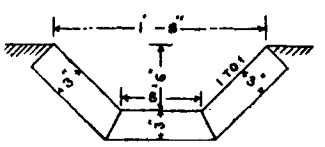
SCALE 4 FT — 1 INCH

SANITARY BOARD
BEHAR & ORISSA
TYPE PLAN No 1



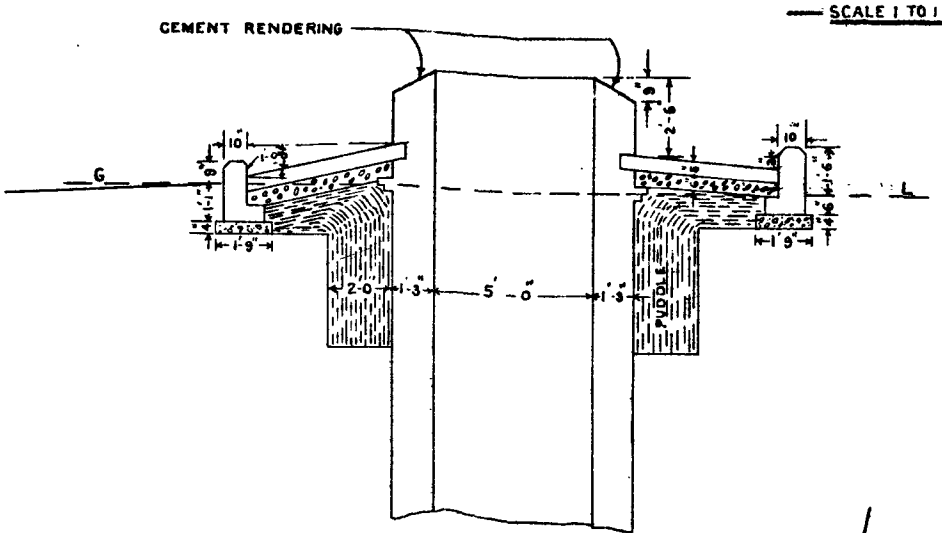
LENGTH OF DRAIN TO BE NOT LESS THAN DEPTH OF WELL.

PLAN



SECTION ON B.B.

SCALE 1 TO 1 FOOT



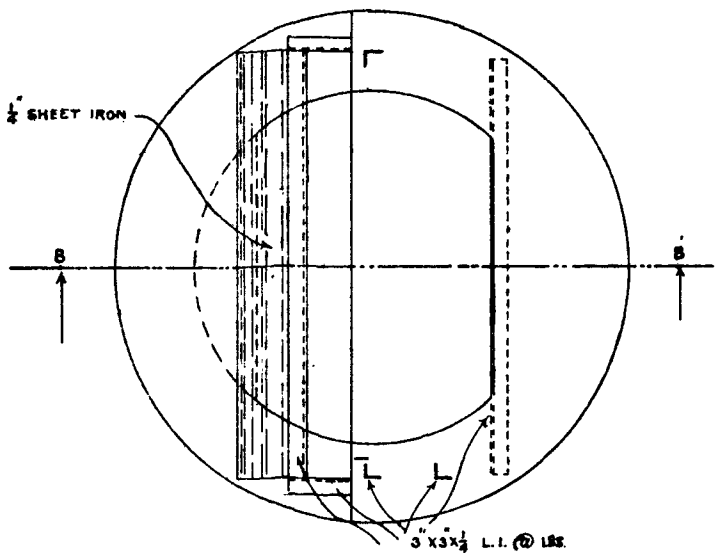
SECTION ON A.A.

H. a. macay
EXECUTIVE ENGINEER,
HAZARIBAGH DIVISION.
5/11

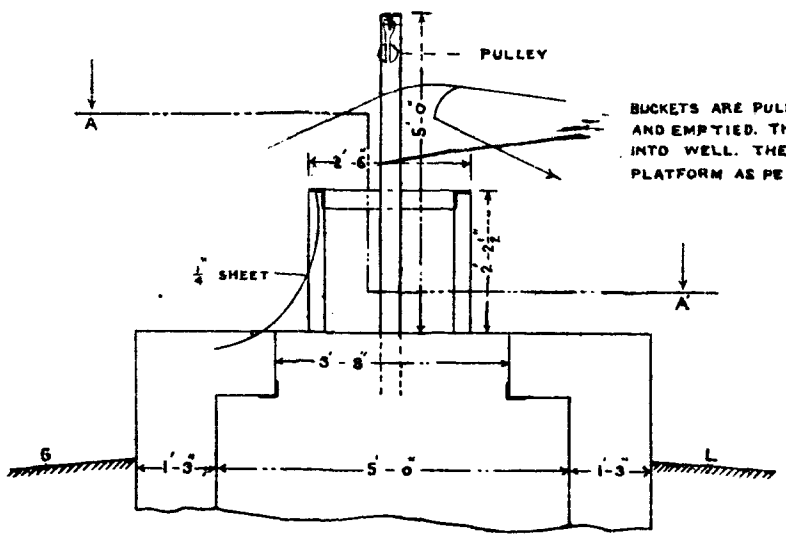
WELL HEAD

HAZARIBAGH DISTRICT BOARD

SCALE ½ INCH = 1 FOOT



PLAN ON A.A.



BUCKETS ARE PULLED IN THESE DIRECTIONS AND EMPTIED. THE SHEET IRON PROVIDING RE-ENTRANCE INTO WELL. THE WELL SHOULD BE PROVIDED WITH A PLATFORM AS PER PLAN No. 1

SECTION ON B.B.

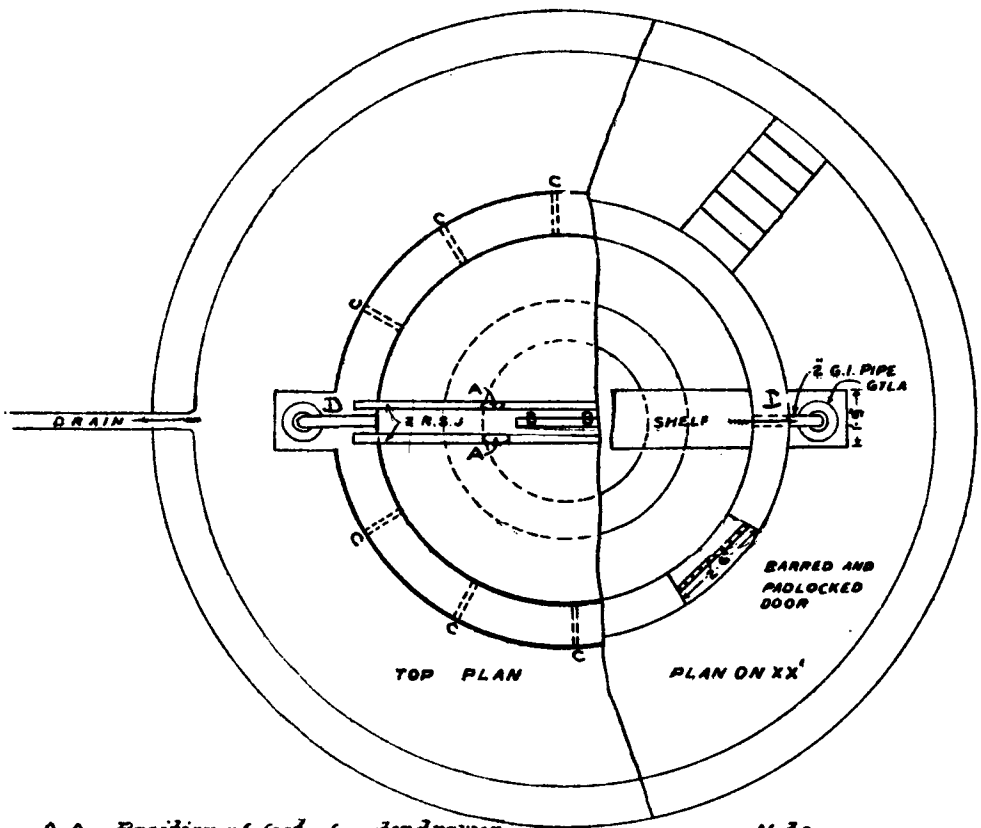
EXECUTIVE ENGINEER.
HAZARIBAGH DIVISION.

T. by A. Wahab.

PLATE Nº 3.

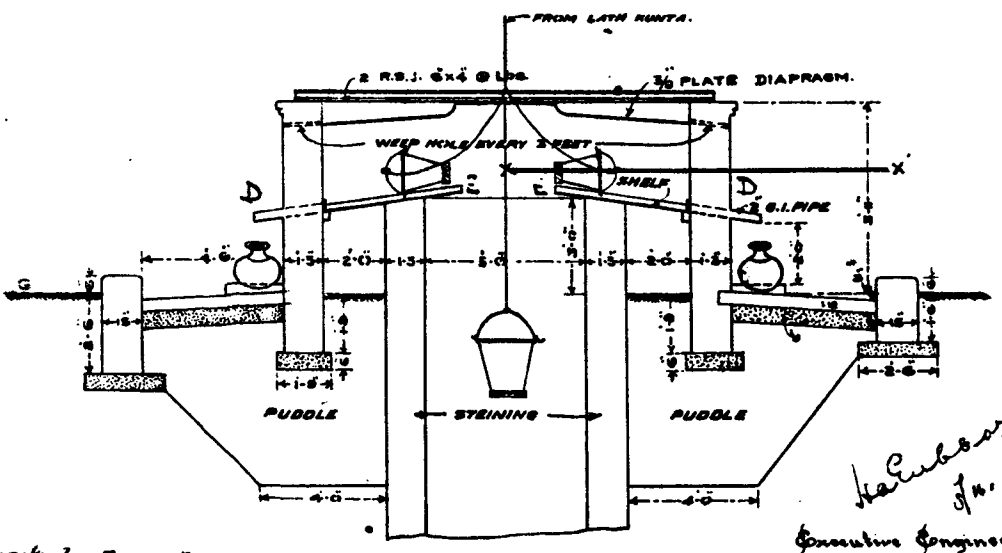
WELL HEAD DESIGNED BY MAJOR STEVENS I. M. S.

SCALE ¼ INCH=1 FOOT



A.A. – *Position of feel of water drawer*
B.B. – *slit through plate diapragm*
C.C. – *Weep holes*
D.D. – *Outlet pipes*
E.E. – *Shelves*

Note :–
2 buckets and 2 lath kanta would usually be employed only one Bucket is shewn



Executive Engineer.
Mozaffargarh Division

Surveyed by S.M.B.

A mark on the rope or chain can be placed to give him an idea when this takes place. He then pulls the rope or chain towards himself and lowers the bucket on to the shelf and upsets it. The water runs into the ⌊____⌋ shaped shelf E and out through the pipe provided in the outer parapet—into the receptacle. One, two, three or any number of outlet pipes may be provided for different castes or to prevent overcrowding. It should be noticed that the inner and outer parapets are not connected, thus providing at all times (by means of the clay puddle) and especially should the well shaft sink after construction, an impervious strata preventing the re-entrance of used water. An impervious apron and drain conducts the used and waste water away.

An opening, grated and padlocked, is provided in the outer parapet enabling buckets to be hung and ropes repaired.

HARDWAR.

Papers presented to the Conference in connection with the inspection visit to Hardwar.

BY

Mr. C. H. WEST.

Sanitary Engineer, United Provinces.

THE Hardwar Union consists of four separate little towns, *viz.* :—Hardwar (population 5,400), Myapur (population 1,600), Kankhal (population 6,000), and Jawalapur (population 17,000) which are grouped together for purposes of Municipal control under one central board. The ground covered by the Union is about 7 miles in length and it varies in width from 100 feet on the Bhimgoda road to 1¼ miles at Kankhal. Hardwar itself is situated on the right bank of the Ganges at the point where it emerges from the hills. It derives its importance from a sanitary point of view from its being one of the most sacred places of pilgrimage for Hindus. The numbers of pilgrims visiting Hardwar vary from a few thousands daily to 100,000 on ordinary large fair days, and during the Adh-kumbh and Kumbh melas occurring once in six years and once in twelve years these numbers may go up to 300,000.

During Kumbh fairs the land available within the Union is not sufficient for the accommodation of all these pilgrims and about 200,000 of them are encamped on the Islands of Lalji-wallah and Rohri-wallah.

To cope with these large numbers special arrangements have to be made and a special Sanitary staff employed. If this were not done Hardwar would soon become a hot-bed of disease and a focus from which epidemics would spread all over India and even beyond its borders. In the Kumbh fair at Hardwar in 1892 there was a very bad outbreak of Cholera. This was followed later by outbreaks in Eastern Europe and Hamburgh. A statement was made in Parliament that the origin of the cholera outbreak at Hamburgh had been traced to Hardwar and the attention of the Indian Government was drawn to the urgent necessity of improving the sanitation of Hardwar. An enquiry followed and it was decided that the two most sacred bathing-places at Harkipairi and Bhimgoda required improvement. A sum of Rs. 80,000 was given by Government for the work in January, 1893, with orders that the work should be completed before April 1893 in time for the annual fair held in that month. At that time the Harkipairi consisted of a narrow set of steep steps only about 30 feet wide leading to a pool which owing to the formation of a sand bank was more or less a backwater of the Ganges with no flow in it. The Bhimgoda tank was a small katcha tank fed by a spring with no inlet or outlet. The bed and sides of these bathing-places consisted of inky black earth resembling sludge both in appearance and smell and the condition of the water after thousands had bathed in it can be better imagined than described. The work which had to be done at Harkipairi was to increase the width of the stairs from 30′ to 100′ to make the bathing-place pucca and arrange for a proper flow of water through it at all times with an open inlet on the upstream side and a covered outlet under a platform facing the temples on the downstream side. A second set of steps were also provided on the upstream side a little above Harkipairi to allow of traffic regulation at the time of very big fairs.

At Bhimgoda the tank was made pucca and an oval drain made to admit water into the tank from near the Dhudia bandh with an outlet into the Ganges in front. These works were completed in time for the fair in April and opened by Sir Charles Crosthwaite the then Lieutenant-Governor. The writer was employed on the construction of these works as Assistant Engineer and was subsequently employed in drawing up preliminary reports for other sanitary improvements such as drainage, etc., but the Local Government had no funds to spare and nothing further was done for some time.

In 1895, a water-supply scheme costing 4 lakhs for the Hardwar Union was prepared by the Sanitary Engineer, Mr. Perrian. He allowed for a supply of 10 gallons a head per day with a large storage tank for pilgrims. The water was to be pumped from near Ranipur, 6 miles from Hardwar, from percolation wells on the

banks of the Ganges canal by means of pumps coupled to turbines worked by the canal falls at Ranipur but the scheme also was shelved for want of funds.

Later on a small drainage scheme was got out by Mr. Wood, Sanitary Engineer for Hardwar amounting to Rs. one lakh. This scheme dealt with Hardwar proper omitting the portion above Harkipairi and the outfall discharged into the Ganges at Lalta Rau above the Myapur regulator. The scheme was not taken up either and nothing was done.

With the closer attention now being paid to sanitation of pilgrim centres and the probability of financial assistance being forthcoming the question of giving the Hardwar Union a good water-supply and a complete drainage scheme has again been revived. In the meantime the construction by the Irrigation Department of an Electric Power Station at the Bhadurabad falls worked by canal water with an electric main laid passing Hardwar to Dhudia where the new permanent headworks of the Ganges canal are to be made has furnished us with a new source of power for pumping either water or sewage for Hardwar and in the new schemes now being prepared this power will be utilised for doing any pumping required and also for lighting the Union.

Canal works.—

I will now give you a very brief description of the canal works now in hand as I understand that the plans proposals will be explained more fully by the Irrigation officers on the spot at Dudhia, though I am afraid that the difficulties in regard to transport will prevent us visiting the Electric Power Station at Bahadurabad. The cold weather bed of the Ganges at Hardwar is composed of several channels separated from each other by large accumulations of sand and boulders which frequently change their positions. Up to the present the impounding of the water of the Ganges has been carried out by means of temporary weirs thrown across these channels. The weirs consist of large wooden crates filled with boulders and sunk in position and then strengthened. More than one line of crates is needed to stop percolation. These temporary weirs have to be reconstructed after each rains and last till the following rains when they are washed away. The construction of these weirs cannot be undertaken until the river has fallen fairly low and has to be pushed through as soon as possible, and even so, much valuable time is lost for purposes of Irrigation.

After a great deal of consideration it has now been decided to construct a permanent weir for the Ganges at Dudhia. The work is one of considerable magnitude, difficulty, and cost, but when once completed it will save all the trouble of putting in temporary weirs yearly. It will also ensure the Ganges canal a sufficient supply of water at all times and enable the available supply to be more completely impounded.

In order to carry out the construction of this a good deal of power plant was needed. It was at first proposed to get steam plant but it was subsequently shown that electric power generated by the canal falls would be more economical and satisfactory. The site selected for the Power Station was at Bahadurabad, 9 miles from Hardwar. At this point by combining two smaller falls by means of a head and tail race 18 feet of head is obtained for working turbines. Several thousand horse power can be obtained here but for the purposes required three units of 250 H. P. each have been put in. This power is transmitted to Dudhia where it does all the mechanical work necessary. The intention is that after the Dudhia works are complete the Electrical plant at Bahadurabad will be retained and will supply light and power to Hardwar and Rurki.

Reverting once again to the proposals now in hand for improving the sanitation of the Hardwar Union I will explain briefly the lines on which the schemes are being prepared and will deal with the water-supply proposals first and then afterwards with the Drainage Scheme so far as they have been matured at present.

Water-supply.—

In order to avoid all trouble about settlement and filtration the water for the water-supply will be drawn from percolation wells or galleries. The soil here is composed entirely of sand and boulders with very strong spring from which an ample supply of clear potable water can be obtained without trouble. Two sites have been proposed for these wells. One at Dudhia above the permanent weir for the canal and the one at the foot of Siwaliks half-way between Hardwar and Jawalapur. The cost of these two alternative schemes come to 5 lakhs and 4 lakhs respectively. The reason for proposing the first scheme when a much cheaper solution can be had is that the Hardwar Union is almost entirely populated by Brahmans and it may be necessary to cater to the religious prejudices of these men and to the pilgrims by supplying them with Ganges water drawn from infiltration wells or galleries directly on the banks of the Ganges even at the additional cost.

If the water is drawn from the Dudhia site it will be pumped direct into a large service reservoir placed at Nyasota on the hill above Harkipairi from which the distribution will be made but if the second site is selected the service reservoir will be placed on the spur in the vicinity. With the exception mentioned above the two schemes are identical. For purposes of supply it is proposed to allow 20

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gallons per head per day for a resident population of 30,000 and to allow an additional supply of 3 gallons a head for 100,000 pilgrims who may at any time be located within the Union. This supply of 3 gallons should suffice as most of these pilgrims bathe in the Ganges and many of them consume cooked food either brought with them or purchased in Hardwar.

At all Dharamsalas, lodging-houses and camping-grounds special water tanks for the use of pilgrims will be provided. The water-supply will be a constant one and the distribution pipes are calculated to deliver $\frac{3}{4}$ths of the full daily supply within a period of 8 hours. The water will be pumped by means of turbine Centrifugal Pumps worked by electric motors and the minimum head allowed is 30 feet. The system will be divided into suitable districts controlled by waste meters.

For the large melas such as Adh-kumbh and Kumbh a special pipe line will be laid over the temporary bridges usually constructed to Lalji-walla and Rohri-walla. These pipes will be flangad pipes which will be removed and relaid as required. The pumps will ordinarily work 14 hours a day but during the large fairs they will be worked 24 hours a day to keep the pilgrim tanks and large service reservoirs always full. The cost of this additional supply to Lalji-walla and Rohri-walla with standposts, tanks, etc., is estimated as something under one lakh of rupees. This explains briefly the water-supply proposals which are at present being worked out.

Drainage Proposals.—

It is proposed in the Hardwar town improvement scheme to make a platform on the river face between Bhimgoda and Harkipairi and to extend the Harkipairi platform to below the town. This will be comparatively simple as with the construction of the new weir at Dudhia the main Ganges river will no longer flow past Hardwar and the water passing Hardwar will be only what is needed to feed the canal.

The construction and extension of this platform besides improving the town and removing congestion of traffic on the existing roads will enable the drainage problem to be more simply disposed of.

It is proposed to put a main intercepting sewer all along under this platform and to utilise the outlet water of the Bhimgoda tank as a constant flush for this sewer. This will give ample dilution and keep it sweet and clean at all times and give a self-cleansing velocity. The fall in the Ganges at Hardwar is 4″ in 100′ or between 17 and 18 feet a mile. So a very good fall and velocity can be secured through this sewer.

The sewer will be carried to below the Myapur regulator and it will then be syphoned under the canal to the Kankhal side. The minimum velocity in this syphon will be 5·75 feet a second, so it should never choke up especially as precautions will be taken to prevent heavy road metal finding its way inside. The main drain after crossing the canal will run past Kankhal and pick up all the Kankhal sullage and sewage on its way and it will then be taken on to a suitable plot of land below Kankhal for purposes of irrigation and when the effluent is not needed for irrigation it can flow into the river there.

For Jawalapur there will be two intercepting drains passing round the town carrying all sullage to a point south of the town. This sullage can probably be taken on to suitable land south of Jawalapur by means of gravity, but if suitable land at a low level cannot be obtained it may be cheaper to pump it by a centrifugal pump and electric motor. These levels have been taken but have not been worked out or plotted, so it is difficult to say definitely what will be done just at present.

The levels taken for Kankhal and Hardwar show that suitable gradients for a sewer as outlined can be obtained and the outfall can be kept sufficiently high to command land for irrigation purposes. The syphon will be laid on the bed of the canal and at any time that the canal is shut for repairs the pipe can be examined and be attended to.

The drainage scheme will deal with sullage and sewage water only. All storm water which in Hardwar is very heavily charged with silt will be rigidly excluded and go direct into the Ganges as at present.

I may mention that this drainage scheme is still in embryo, but these are the main lines on which it is proposed to work it out.

II. HARDWAR.

1. Kapila called after a sage of that name whose dwelling is commemorated in Kapilastan, Kapil is supposed to be identical with Kutail mentioned by Timur.

2. Gangadwara (Gate of the Ganges) known by this name as far back as the 7th century.

3. The Chinese traveller Hieun Tsang described the town as Moyulo probably Mayura or Mayapur.

4. Haridwar (named after Vishnu) or Hardwar (named after Shiva), each name being claimed as correct by the votaries of the respective deities.

General description.—Akhbar the Great had his mint here and it is also, said that his drinking water was also sent for from here.

It is a small town which has grown to its present size (of a mile in length to about 600 yards in width) from 15 ft. wide and 1½ furlong in length. It lines on the left bank of the Ganges at the foot of the Sewaliks. It lies on the sloping ground which is higher on the North and slopes towards the South-east. All the drainage of the town and water during the rains from the hills flows into the river at various points. Two roads run almost parallel to each other. One between Jwalapur and Harkipairi and the other a little lower down from the first to Mayapur regulator.

River Ganges divides into several streams and the western-most branch separatting about 2 miles up the stream rejoins it below Kankhal. It has got various sites of interest both for the religious man and the antiquarian :—

Sites.—1. Bhimgoda according to one authority Bhimsen (one of the 5 Pandavas) was deputed at this spot to guide the course of the stream in its descent and the kick of his horse forms what is called Bhimgoda tank or Bhim Ghora. Whilst according to another source it marks the spot where Bhim placed his Goda (a weapon) in order to perform the purification ceremony (Prayaschitta) after the great battle of Mahabharat.

2. Brahmakund also described by the Chinese traveller marks the spot where Brahma performed Yagya (offered ghi and dry fruits, etc., to the fire after reciting Mantras).

3. Harkipairi. Here are to be found the footprints, on the wall, of Vishnu the Preserver. Originally it was only 34ft. at the top and with 39 steps leading on to the sacred water of the Ganges. A bath here on propitious occasions was and is considered very sacred leading one to the attainment of Salvation. Being rather narrow and limited it had often been the source of loss of life on such occasions. As in 1820 when a desperate rush by an infatuated crowd was made and 430 persons were crushed to death including sepoys stationed as guards.

The Government built a ghat of 60 steps with 100 ft. in width, to avoid such a recurrence in future. In 1892, cholera broke out during the Kumbha, when the Hardwar improvement society was formed which gave place to a Fair fund later on. As the result of which various improvements in the sanitary condition of the place have been undertaken, which are mentioned below :—

I. The bathing-ghat place at the Harkipairi has been paved and so constructed as to secure a strong and constant flow of water past the Ghat.

II. Iron railing is also provided to keep back persons being carried away into the deeper parts especially in the rainy season.

III. In front of this ghat the portion of land has been rendered *pucca* with a flight of steps and a ferro-concrete bridge has been set up for persons going across and thus helping a great deal in reducing congestion so essential on big bathing days.

IV. Esplanade has been made from Harkipairi to Kushavart Ghat at a cost of about Rs. 25,000, which adds very much to the beauty of the place besides being of immense use to the pilgrims. It is lighted all along with incandescent lamps.

V. Dispensary has recently been enlarged, and operating room and indigent ward, having been added and an Assistant Surgeon has been placed in charge.

VI. Infectious disease hospital is under construction, on the other side of the Railway line.

VII. Ferro-concrete bridge over Lalta Rao.

4. Manmandir was built by Raja Mansingh placed disputed and dedicated to 5 Gods.

5. Gangadwara temple. The most important of the temples has been the seat of bloody affrays in the past between the rival sects, in 1790 Goshains and Bairagis fought and 1,800 perished, and in 1795 the Sikh pilgrims and 500 Goshains.

6. Kushavart Ghat (Kusha sacred grass and Avart a circular thing) marks the spot where this grass used to grow in abundance and the Ganges used to flow through it.

7. Vishnu Tirath, the place where the God Vishnu performed " Tapy."

8. Temple of Sravan Nath built after the pattern of Pashupati Nath in Nepal. It is said that on the Sthapan ceremony, the Chiefs of Nepal, Jodhpur, Bikaner, Udaipur, etc., assembled and a very big feast was

given to all present. Very recently a bathing ghat for *purdah-nashin* ladies has been built, which is very artistic.

9. The temples of Mayadevi and Bhairon in front of the present dispensary are also ancient buildings. The former according to Cunningham has very ancient sculpture.
10. Narayani and Pret shilas in Mayapur as also the fort of Raja Vina close to the present Municipal office.
11. Mayapur (Maya a miracle) so called because Vishnu showed a miracle to a Brahman named Vishnu Sharma. It is regarded to be one of the seven sacred places in India, the other six being Ajodhia, Muttra, Kashi, Kanchi, Avantika, Dwarka.

Kankhal.—The town of Kankhal lies between the east bank of the canal and the river about a mile south from the Mayapur headworks. It covers a considerable area, lying on both sides of a good stone paved bazar lined with substantial brick shops and large houses. The place has a very clean and picturesque appearance, with numerous fine trees and temples, many of the houses being decorated with fantastic paintings. There are also several good gardens surrounded by high walls and approached through handsome doorways. The Chief zamindars are a rich and influential body of Udasi fakirs presided over by a Mahant, who is elected by the Panchayet of the brethren. Besides their religious duties they carry on a considerable trade in money-lending and own a large amount of land in the Rurki Tehsil. Besides that of the Udasis there are several other Akharas in Kankhal, including the Nirmalas, Nirbanis and Niranjanis. The streets of Kankhal are frequented by numerous sacred cattle which are fed by the pilgrims, who throw down fodder for them in the circular space in the centre of the Bazar. The population for the most part consists of Brahmans connected with the temples here and Hardwar, who inter-marry exclusively with those of Jwalapur. During the mutiny the towns-people, led by the rich Mahajan of the place, successfully resisted the attacks of marauders from the south of the parganah and from Rajibabad on the Bijnor side of the river. Kankhal now contains a Police outpost and a post office. It was visited by plague in September 1897, and during the course of the next two months 61 cases occurred : but the outbreak was successfully dealt with by the systematic and complete evacuation of the inhabited quarter.

The principal temple stands in the southern extremity of the town and is called the Daksh temple, or more properly the Dakheswara. It is said to mark the spot known as Kankhala in the Purans where Mahadeva spoiled the sacrifice of Raja Daksh, and where Sati or Uma, the daughter of Daksh and spouse of Mahadeva, immolated herself into the fire. The temple is enclosed by a quadrangle surrounded by cells and containing, in addition to the main building in the centre, a number of deserted shrines, as well as that of Hanuman, at which worship is still carried on, and a small building with a bell presented by the Maharaja of Nepal in 1848. Outside are three large houses for the accommodation of pilgrims erected by the Raja of Landhoura. Formerly the Ganges flowed close under the walls of Daksh, but a series of floods changed the course of the stream and at the same time ruined many of the gardens that formed the chief adornment of the town. The greatest damage was done by the Gohna flood of 1894, which destroyed a number of houses along the river front in Kankhal, though the rise of 12ft. left Hardwar practically unscathed. The matter was taken up by Government, and some temporary protective works were carried out at a cost of some Rs. 800, diverting the stream to the east and leaving a broad expanse of boulders between the town and the dry weather channel. Subsequently a large bandh of boulders was constructed at a considerable expense but this proved inadequate. It was then estimated that very large expenditure would be necessary in order to ensure thorough protection, and the Government undertook to contribute Rs. 15,000 on the condition that the Hindus subscribed twice that amount, but the stipulation was not fulfilled and nothing further has since been attempted, though the work has now been taken in hand by the Canal Department.

There are many other temples in Kankhal, but none is of any great age or deserves special mention, excepting perhaps the chuttri erected some 25 years ago by the Landhoura Estate. It stands on the flood bank and is built on a massive stone platform with unusually deep foundations, so that the structure should be able to withstand the action of the river. The view from the summit is extremely beautiful taking in the sacred hill of Chandi and its temples on the opposite bank of the stream, as well as the river and Hardwar, beyond which rise the outer hills crowded by the snowy peaks of the Himalayas.

HOW TO CHECK THE GROWTH OF INSANITARY CONDITIONS IN BOMBAY CITY.

BY

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FOREWORD.

THIS paper was not originally intended for the "All-India Sanitary Conference." For some time past there have been in progress in Bombay Conferences—

(1) by a Committee appointed by Government to consider the suggestions made by Mr. Orr in his lecture of 27th June 1912 on "Light and Air in dwellings in Bombay;" and

(2) a Committee appointed by the Bombay Municipal Corporation to amend the Municipal bye-laws with special reference to the open air space around buildings.

Both Committees showed an inclination to approve the Bombay City Improvement Trust's $63\frac{1}{2}°$ rule; but it was clear that several of the members did not understand the rule. The bare statement of the rule, as set out in some of the Trust's building regulations, was not sufficiently informing, as it did not cover the whole range of the Trust's practice in applying the rule to the various questions that arise in connection with the lighting and ventilation of buildings; the author therefore decided to write a detailed note explaining the rule and showing how it was applied in actual practice, and he took the opportunity to point out how the adoption of this rule by the Municipality would result, as it has resulted in the Improvement Trust Estates, in the elimination of the main causes of the insanitary condition of Bombay as set out in a report made to the Corporation by the Municipal Commissioner (the late Mr. W. L. Harvey) so long ago as 1901.

The author's excuse for obtruding upon an "All-India Conference," a paper dealing merely with certain defects in houses in Bombay City, is that he believes that there are other large cities suffering from insanitary development in the past, and that a consideration of remedies suggested for Bombay may lead to the adoption of effective remedies in these other cities.

1. In the printed proceedings of the Bombay Municipal Corporation of 13th May 1901 is to be found an admirable Report* (No. 2082 of 26th April 1901) in which the Municipal Commissioner, Mr. Harvey, set clearly before the Corporation the principal defects in the Bombay Municipal building regulations with his suggestions as to how these regulations and the Municipal Act should be amended so as to remove these defects.

2. The Bombay City Improvement Trust promptly adopted nearly all of Mr. Harvey's suggestions in framing building regulations for their estates, and in 1905 some of Mr. Harvey's suggestions were adopted in Bombay Act V of 1905 by which the Bombay City Municipal Act was amended. *Unfortunately the legislators of* 1905 *ignored all Mr. Harvey's recommendations for provisions of air spaces round houses.* They relied on the Municipality to deal adequately with this matter in bye-laws: but it was not until 1910 that the discussion on Mr. Harvey's suggestions ended in the passing of revised bye-laws; and in the course of the discussion the regulations proposed by Mr. Harvey had been hopelessly emasculated and devitalized before they took the shape in which they were finally approved. The 1910 bye-laws effect some improvement in the case of new buildings, *but the insanitary condition of the older and more congested building areas must continue to go from bad to worse so long as the control of building operations on old buildings remains as ineffective as it now is under the Municipal bye-laws.*

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* This, with a précis of the Corporation's subsequent dealings with it, is reproduced in Appendix C.

3. *Mr. Harvey's object was to bring all building operations under sanitary control. He made a very strong point of the necessity of applying the building regulations he proposed to existing buildings whenever they might be substantially altered,* and he would never have been content to see them applied only to new buildings and only in the very small portion of the city occupied by the Trust's estates. Still the Trust's estates have supplied examples to show how beneficial to sanitation the Trust's regulations framed on Mr. Harvey's proposals are ; and people are gradually beginning to realise that the Municipal Act and the 1910 bye-laws are, at any rate in regard to the lighting and ventilation of human habitations, very defective and that Mr. Harvey was right in urging that the far stricter regulations now embodied in the Trust's " 63½° rule " should be applied to all parts of Bombay and enforced for the regulation not only of new buildings but also of old buildings undergoing substantial alterations.

4. *The main object of this note is to show how the adoption of the Trust's " 63½° rule " and of such of Mr. Harvey's proposals as are not covered by it can be made the means of gradually abolishing the glaring defects in the older and even some of the newer houses and in the development of building sites and estates which have so much to do with the insanitary condition of Bombay City.*

5. The first thing necessary is that the reader should have a clear idea of what is meant by " the 63½° rule," as it is commonly called, and how it is applied in actual practice. " The 63½° rule " is a convenient expression for ordinary talk ; but strictly it covers a whole series of rules directed—

(*a*) towards securing ample air space in rear of every house—this is the object of " the air-plane rule " (rule 4) ; and

(*b*) towards securing ample light for side and interior rooms, intended for human habitation—this is the object of " the light-plane rule " (rule 5).

6. The rules in their simplest form may be set out as follows :—

THE BOMBAY CITY IMPROVEMENT TRUST 63½° AIR-PLANE AND LIGHT-PLANE RULES.

" Every person who shall erect a building on a Trust plot shall provide it with adequate means of access for external air on its rear side and shall provide every room intended for human habitation in it with adequate means of access for external light to the satisfaction of the Plans * Committee who will ordinarily be guided by the following rules :—

Definitions.—1. (i) " Rear air-plane." The plane lying between the ground behind a building and the 2 straight lines drawn downwards and outwards from the extremities of the line of intersection of the outer surface of any rear wall of the building with the roof perpendicular to that line and at an angle of 63½° to the horizon is for the purposes of these rules described as a " rear air-plane." (*Vide* Diagram No. I.)

[NOTE.—The 63½° angle has a tangent of 2 : 1 ; so the air-plane always reaches the ground at a distance from the exterior wall equal to half the height of the wall above the level of that ground.]

Explanation.—Ordinarily every wall on the side of a building opposite to the side which abuts on a street or, in case the building abuts on more streets than one, the side opposite to the side which has the longest frontage on a street is taken to be a rear wall for the purposes of these rules. In cases in which the building abuts on no street and in other cases in which for any reason there is room for doubt as to which should be treated as the rear walls of a building for the purposes of these rules, the Plans Committee will decide the point, having regard to the probable lay-out of roads and houses in the vicinity in the future and to the desirability of making each owner contribute his fair share to a common rear open space between rows of buildings.

2. (ii) " Light-plane." The plane lying between the line of intersection of the floor of any room in a building with the outer surface of an exterior wall of the building and the 2 straight lines drawn upwards and outwards from the extremities of that line perpendicular thereto and at an angle of 63½° to the horizon is for the purposes of these rules described as a " light-plane." (*Vide* Diagram No. II).

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*The Plans Committee is a Committee to which has been delegated the Trust's power to approve or disapprove plans of houses to be built on the Trust's Estates.

(ii) "Permanently open air space."

3. An air space is deemed to be permanently open if—

(i) it is encroached upon by no structure of any kind, and

(ii) its freedom from such encroachment in future is assured either by law or by Municipal bye-laws or by the fact that the ground below it is a street or is appropriated as a permanent open space or otherwise.*

Standards.

(i) "Rear air space."

4. *A building is deemed adequately provided on its rear side with means of access or external air, if the whole space vertically above all its rear air-planes is a permanently open air space.*

(ii) "Lighting of rooms for human habitation."

5. *A room is deemed adequately provided with access for external light for the purpose of human habitation, if the whole space vertically above at least one of its light planes is a permanently open air space.*

7. All buildings on Trust Estates abut on streets; and adequate access of light and air to the *front* rooms is incidentally secured by section 349B† of the Bombay City Municipal Act which limits the height of buildings according to the breadth of the streets into which they abut. *The rules set out above are directed towards securing ample exterior open space in rear of all buildings, whether intended for human habitation or not, and ample interior and side open spaces for the lighting and ventilation of rooms used for human habitation that are not lighted and ventilated from the front or rear of a house; they practically limit the portion of a building site on which the building may be built, so that the plinth can never be co-extensive with the site: and incidentally they also limit the height of the rear part of every building in proportion to the open space around it, on the principles—*

(1) *that the higher and the more extensive a building is, the greater must the open space around it be, and*

(2) *that such exterior open space is just as much a* sine qua non *for a house as the plinth, walls or roof.*

8. A full and detailed explanation of these rules and of the methods actually followed in applying them to the Improvement Trust Estates and suggested for adoption throughout Bombay City will be found in Appendix B. For a reader who wishes to adopt or adapt these rules elsewhere a careful study of Appendix B will be found very necessary; but for the general reader the simple statement of the rules given in paragraph 6 will probably suffice, and that is why the more detailed exposition is banished to an Appendix.

Height of Buildings.

9. Up to 1905 the only provision in the Bombay City Municipal Act limiting the height of buildings was section 348 (*1*) (*e*) which prescribed that buildings abutting on roads of less width than 50′ and erected after 1888 on sites not previously built upon should not exceed in height 1½ times the width of the street; but, thanks to Mr. Harvey's representations, sections 349A and 349B‡ were introduced into the Municipal Act in 1905. Under section 349A buildings cannot be raised to a height greater than 70′ except under the Municipal Commissioner's special orders in special cases. Section 349B limits (*vide* Diagram No. III) the front height of buildings abutting on streets 40′ or more wide to the width of the street. It leaves unchanged the original law as regards front of buildings that abut on streets 26′ wide or less, limiting it to 1½ times the width of the street, while in streets between 26′ and 40′ in width it fixes the maximum height at 40′; *but unfortunately there is no corresponding legal limit for a building that does not abut on any street.* Mr. Harvey pressed for an enactment that every new building or compound in which a building is to be erected must abut on an existing or projected street of at least 40′ in width and that applications to build in positions in which this condition was not satisfactorily provided for be liable to rejection; but this recommendation seems to have been overlooked by the legislators of 1905 *and consequently the Municipal Commissioner is still powerless to prevent the erection of buildings up to* 70′ *in height in private compounds or alongside of roads, lanes, courts, alleys, etc.,*§ *over which the public have no right of passage, however much they shut out light and air from other buildings.*

10. There are numerous localities, notably Girgaon and Máhim, in which many buildings of this uncontrollable class existed in 1905; and of course a great many more have sprung up since. The existence of many such buildings in higgledy-piggledy disorder creates endless confusion and makes it very difficult to

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* *Vide* suggestion in paragraph 52.

† *Vide* Appendix D.

‡ *Vide* Appendix D.

§ *Vide* definition of "Street" in B. C. M. Act, section 3 (*w*), Appendix D.

lay out regular streets and ensure adequate access for light and air to any new buildings that may be built; and the confusion and difficulty increase very rapidly as such buildings are multiplied in number and the height and extent of individual buildings is increased. *To obviate all this and prevent confusion from getting worse confounded, a law is urgently required prohibiting the extension of any such building upwards or outwards until at any rate the limits of the street on which it is ultimately to abut have been determined. Meanwhile some check may perhaps be put upon the erection of new buildings at a distance from public streets by strict enforcement of the provisions of section* 348 (*1*) (*b*),* though this section, as pointed out by Mr. Harvey, is quite inadequate in so far as it does not put upon property-holders the obligation to provide sufficient accommodation roads when developing their properties, an obligation which is universally enforced in all European Cities.

11. When every building is made to abut upon a street, section 349 (*b*) will operate to limit its height in front; *but there is no corresponding limit to its height in the rear; and under the proviso to section* 349 (*b*) *the builder can raise his building towards the rear up to the maximum of* 70′ *by successive set-backs* (*vide* Diagram No. IV). It is one of the advantages of the rear air-plane rule that in practice it limits the height of the building in proportion to the open space behind the building. On Trust Estates all houses abut on streets at least 40′ wide, so that section 349 secures ample front open space and a *front* air-plane rule is unnecessary; but elsewhere a front air-plane rule could with advantage be enforced with a view to limiting the front height of buildings and providing front air space; *and thus, even without waiting for an amendment of the Act, the Municipality can by adopting the Trust's rear air-plane rule and a corresponding* 45° *front air-plane rule in their bye-laws put some check upon disorderly development even in localities in which buildings do not abut on streets;* and when additional new street lines are laid down, order will be gradually evolved out of disorder; for the application of the air-plane and light-plane rules will in the long run naturally result in owners re-arranging their sites by interchanging odd corners on give-and-take lines and square their buildings to the road lines, because in practice the air and light-plane rules have the effect of giving owners the maximum benefit from air spaces round their buildings when the buildings are regularly arranged in relation to the roads and the intervening air spaces created by the operation of these rules.

Ventilation of Buildings.

(*a*) *Rear open spaces.*

12. It is only incidentally that the air-plane rule limits the height of buildings, its main object is to ensure sufficient access for air to the rear of all buildings.

The question of access of light and air to the *sides* of a building is not one of such general importance as that of access of light and air to the *rear* of buildings, since in many localities buildings are continuous along a street front and the rooms they contain are lighted from the front and rear and not from the side; *but the law ought to provide in the most uncompromising terms for adequate means of access of light and air to the rear of every building; and the absence of such a provision in both the law and Municipal bye-laws in Bombay is a serious defect which has perhaps had more to do with the insanitary development of Bombay in the past than any other defect except the absence of regulations limiting the height of buildings away from streets and of regulations for adequate lighting of side and interior rooms.*

13. *In Bombay outside Improvement Trust Estates there is still, in spite of the provisions of the amending Act of* 1905 *limiting the front height of buildings, nothing to prevent the owners of* 2 *plots backing on to one another from two* 40′ *roads from constructing their buildings in successive set-backs till a height of* 70′ *is reached and next to no space is left between the buildings in the rear* (*vide* Diagram No. IV). *All over the congested areas in Bombay outside Improvement Trust Estates there is generally between two rows of back to back houses, however high, a rear space no more than* 3′ *or* 4′ *broad reeking with filth of every description.*

14. *Recognising the serious extent of this ever growing evil, Mr. Harvey strongly advocated the adoption of the Calcutta bye-laws prescribing a minimum rear open space in every building site for purposes of lighting and ventilation and limiting the height of the building in rear by the* 63½° *rule according to the breadth of the rear open space. This important recommendation, most unfortunately for Bombay, went unheeded, and the evils that result from the want of rear open space between buildings have, by reason of the erection of many new buildings and the addition of new storeys to many old buildings, become very much more serious outside Improvement Trust Estates in the* 12 *years that have since elapsed.*

15. In Improvement Trust Estates a building line is laid down in the ground plan of each plot, and no building is allowed between this line and the rear boundary

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* *Vide* Appendix D.

of the plot. There is thus created along the common rear boundary of adjacent plots, an open air space sufficiently broad to allow of adequate access for light and air to the rear of the buildings, the same function that streets perform for the front. The *minimum* extent of the rear open space is generally determined by the application of the 63½° air-plane rule to a hypothetical building abutting on this space and rising as high as the road on which it fronts is broad. Thus the minimum rear open space between back to back buildings of uniform maximum height throughout their depth on two 80′ roads is 35′ (*vide* Diagram No. V), as the buildings cannot exceed 70′ in height; and as the minimum breadth of roads is now 40′ *the minimum rear open space between two lines of buildings on Improvement Trust Estates is* 20′.

16. The Trust have the same absolute minimum rear open space of 10′ *in each site* that Mr. Harvey proposed; but in recognition of the necessity of subordinating sanitary considerations to economic considerations to a certain extent in localities in which the value of building land is very high, so that the devotion of much land to open spaces involves an unduly heavy financial sacrifice, they allow the whole open space between two houses in such localities to be counted for both houses towards the minimum required for satisfaction of the 63½° rear air-plane rule, instead of requiring each owner to provide the full area *within his own site* as Mr. Harvey proposed and the Calcutta bye-laws require. For instance, between two rows of houses 35′ high the Trust (*vide* Diagram No.VI) would in such localities allow the minimum rear open space of 10′ in each site; because the total 20′ exceeds the 17½′ required by the 63½° rule; whereas in Calcutta a minimum of 17½′ would be required *in each site* and Mr. Harvey would have required 25′ *in each site.*

17. It may be that it was through fear of the hardships that would, on alteration of existing buildings, be involved by the rigid enforcement of the somewhat severe prescriptions suggested by Mr. Harvey that *the legislators of* 1905 *gave the entire go-by to every one of the important recommendations made in paragraph* 3 *of Mr. Harvey's note as to exterior and interior open spaces, leaving the matter to be dealt with by the Municipality in bye-laws; and it may have been the same fear that induced the Corporation when amending their bye-laws* 5 *years later to omit to prescribe any rear open space;* but meanwhile experience in Trust Estates has shown that the Trust's rear air-plane rule combined with the requisition of a minimum rear open space 10′ in width in every building site effects an adequate improvement in congested areas without involving anything like the hardships that Mr. Harvey's more drastic proposals involved; *and it is open to the Municipality to at once arrest the evils resulting from lack of open spaces behind houses by adopting the Trust's rear air-plane rule and their method of applying it to sites on or near which are old buildings.*

18. This method is fully explained in paragraphs 7 to 10 of Appendix B: it hinges on the assumption that the Municipality will shortly adopt a bye-law to the following effect:—

> "Buildings on either side of a common rear boundary shall on reconstruction be set back (*vide* Diagram No.VII) so that the open space between the lower building and the common boundary shall be one-fourth as broad as the lower building is high and the open space between the two buildings shall be half as broad as the higher building is high."

19. In applying the rear air-plane rule to the case of a site back to back with a site already built on, the Trust act as if the old building had already been set back under this proposed bye-law, with the result that, until it is actually so set back, the rear open space is less than it should be under the 63½° standard; this deviation from the 63½° standard is however eliminated so soon as the old building is "reconstructed" and meanwhile a considerable improvement is effected without undue hardship to either of the parties concerned.

20. Such concessions to landlords are however unnecessary in localities in which the building sites have not long been built upon; *and there a closer approximation to the Calcutta standard may be secured by requiring each site to have sufficient rear open space to allow of the* 63½° *rear air-plane reaching the ground within the site and not covering any part of the adjacent site* (*vide* Diagram No. XXXI in Appendix B).

(*b*) *Side open spaces.*

21. The shocking defects in insanitary houses of the 2 types commonest in Bombay are fully set out with special reference to side and interior rooms in Appendix A to my lecture on "Light and Air in Dwellings in Bombay," from which Diagrams Nos. IX and X are taken. A glance at Diagram No. IX will at once show that the cutting off of a 10′ strip from the backs of the houses shown therein (deep houses with most of their rooms dependent on side gullies for light and air), as a contribution towards a rear open space 20′ broad between these houses and those in their rear will leave the bulk of the rooms as devoid of light and air as before. Even in houses of the shallower and more regular type shown in Diagram No. X the provision of a 20′ rear open space will not benefit interior rooms which are too far from both front and rear to be adequately lighted and ventilated from those faces.

22. Section 348* (*1*) (*e*) of the Bombay City Municipal Act was no doubt directed towards meeting this difficulty, and the legislators no doubt anticipated that, while the law laid down *minimum* dimensions, bye-laws would be framed to make the *actual* dimensions of side spaces and interior chauks sufficient to ensure adequate lighting and ventilation of side and interior rooms ; but unfortunately *no such bye-laws were framed until* 1910, *and meanwhile the practice was for builders to evade the law by representing buildings really intended, and before long, actually used as chawls as not being chawls, so that side spaces could be kept at the minimum of two feet breadth, while all chauks, even in buildings* 70′ *high, were of the minimum dimensions* 6′ × 6′. *The consequence is that side gullies, however long and crooked, are commonly only* 3′ *to* 4′ *broad, even when the houses on either side are* 70′ *high. Moreover, eaves overhang and windows project into these side gullies, and as open drains fed by sullage and even in some cases sewage are laid in them, and filth of all kinds is thrown into them from the side windows, the air in them is so horribly foul that it is dangerous to keep the windows overlooking them open.*

23. Mr. Harvey's recommendation for dealing with this serious evil—the inadequacy of side open spaces for the purpose of lighting and ventilating side rooms abutting thereon—was :—

> " (*a*) The whole of at least one side of every room should be an external wall abutting on the open air or should abut on an interior open space.
>
> " (*b*) Such external wall when situated at the side of the building should abut on an open space of *not less than ten feet* in width extending along the *whole length of the wall* and belonging exclusively to the building. In this space no open drain except for rain-water should be allowed. "

24. This important recommendation was entirely ignored by the legislators of 1905. It was no doubt considered by the Committee who drafted the bye-laws of 1910 ; but the new bye-law on the subject (No. 41, *vide* Appendix D), though it does effect some improvement, is most unfortunately worded so as to be easily evasible, and 3 years' experience shows that in practice it does too little towards securing to side rooms adequate lighting and ventilation. The maximum side space it requires is 6 feet even for a 70 feet building ; and though this space must appertain exclusively to a particular building, so that between two *new* 70′ buildings the side space would be 12 feet, if there were in *both* houses rooms depending on this side space for light and air the 6′ space is allowed between a new 70′ building and an old one built up to the boundary of the adjacent site. These spaces fall far short of those recommended by Mr. Harvey and those required by Trust rules and result in side rooms being for no good reason required to satisfy a far lower standard of lighting and ventilation than front rooms. If the 70′ building is a chawl the side space is increased to 9′ ; but the definition of " chawl " is very unsatisfactory and easily evaded. The distinction between chawls and other buildings is adopted from section 348 (*1*) (*e*) of the B. C. M. Act (*vide* Appendix D), and is entirely groundless and unnecessary ; *there is no good reason why the standard of lighting and ventilation enforced in the case of chawls should not be enforced in rooms for human habitation in all other buildings also.*

25. In some new buildings erected since 1910 there are side rooms which happen to be at present fairly well lighted, because the ends of the side passages are open and they get light from those directions and not merely direct light from over the opposite buildings ; but the ends of the passages may be blocked by buildings hereafter and the rooms will then be inadequately lighted. The bye-law itself permits the blocking up of the ends of side passages with disastrous results, which can be seen in blocks of deep houses which front on two parallel streets. There the effect of the bye-law when an old 44′ house adjacent to a 66′ house is reconstructed is to perpetuate the old insanitary gully 2′ or 3′ wide on the two frontages and to have it broadened in the middle to only 4′ thereby practically creating a 4′ chauk, used as a rubbish shoot, which will never be kept properly clean, because of the difficulty of access from the two ends. An actual case of this kind is depicted in Diagram No. X-A which also illustrates how much more serious the evil of inadequate side spaces becomes when new storeys are added to the adjacent houses.

26. The adoption of Mr. Harvey's recommendations (section 23) would result in the substitution of 20′ minimum side spaces between houses for the old 3′ and 4′ gullies for the lighting and ventilation of all rooms that cannot be adequately lighted and ventilated either from the front or from the rear or from interior chauks. *The Trust light-plane rule has exactly the same effect in the case of houses* 40′ *high above plinth level ; but the minimum side open space is* 10′ *between buildings, not* 10′ *in each holding ; moreover, the side space need not necessarily be half in one man's land and*

[NOTE.—" On reconstruction " will have to be defined and explained ; the set-back ought to be enforced whenever any alterations in rear rooms amounting to more than necessary repairs not affecting the dimensions of the room or the stability of the house are carried out.]

* *Vide* Appendix D.

half in his neighbour's ; and its width (above the absolute minimum of 10′) *varies according to the height of the adjacent buildings and is in general* (vide *Diagrams Nos.* XVIII *to* XXI *of Appendix B) half as broad as the higher house is high above plinth level, so that direct light enters even the lowest room in the lower house at an angle of* 63½° *to the horizontal.*

27. I have no doubt that, in suggesting that the side open space should be *not less than* 10′ in width, Mr. Harvey had in view the broadening of this space under the 63½° rule according to the height of the abutting buildings just as he specifically proposed at the end of the same paragraph for rear open spaces ; but, in the absence of a specific provision in the bye-law he proposed, it would no doubt be held that no more than 10′ side open space could be required between an old building 68′ high already constructed right up to the edge of its site and a new 68′ building. In such a case, the Trust light-plane rule strictly applied would require a 33′ side open space (*vide* Diagram No.XI), while the existing Municipal bye-law 41* requires no more than 6′ : but as in the case explained in paragraph 19 above, so in the case cited, in anticipation of the old building being set back on reconstruction, the Trust would allow an *ad interim* deviation from the strict rule and require only 16½′ to be reserved as side open space in the new building site. Even this 16½′ required by the Trust sounds a lot to give up to open space compared with the 6′ required by the Municipality : but there can be no doubt that the 6′ is altogether inadequate and results in the ground floor rooms being very dark and ill-ventilated.

28. The 33′ required by the Trust between new 68′ buildings is generally divided equally between the two buildings so that each contributes 16½′. Moreover, this open space extends not through the whole depth of the building but, as explained in Appendix B, paragraph 4, and Diagram No. 15, only alongside the rear extensions for so far as there are rooms which cannot be lighted from the front or rear of the house, or from interior chauks. On the other hand, between 22′ buildings the Trust require (*vide* Diagram No. XII) only 10′ side open space (if any) and between 32′ buildings 15′ and it is only when the buildings on either side are 42′ high that the minimum of 20′ suggested by Mr. Harvey is required. On the whole, the requirements of the 63½° light-plane rule represent the mean between the prescriptions suggested by Mr. Harvey and the too lax requirements of the Municipal bye-laws. *The rule is found to work well in actual practice and may with great advantage be adopted by the Municipality.*

(*c*) *Interior open spaces—chauks.*

29. Chauks or interior open spaces within buildings have always been a feature of buildings in Bombay. They are necessary in deep narrow buildings for the lighting and ventilation of rooms in the centre of the building ; but unfortunately *they have never outside Improvement Trust Estates been made of sufficient dimensions to admit of the proper lighting and ventilation of ground floor rooms. In buildings occupied by one room tenements these chauks, being no man's land, are commonly used as rubbish shoots and are rarely kept clean. In the old high buildings in the Fort the original object of the chauk seems often to have been merely to keep a well open to the sky, so that chauks* 4′×5′ *are not uncommonly found in buildings* 70′ *high.*

30. The Bombay City Municipal Act of 1888, section 348 (*1*) (*e*),† limited the superficial area of chauks to an absolute minimum of 6′ × 6′ and further required that this area should be not less than $\frac{1}{10}$th of the aggregate floor area of all the rooms abutting on the chauk, and should be free from any erection thereon *and open to the sky.* Nevertheless, the Corporation passed Bye-law 31 ‡ under this very Act overriding *ultra vires* the provisions of the Act by allowing projections over the open space to the extent of 6″ all round and permitting what was supposed to be open space in the chauk to be crossed by passages between rooms on upper floors.

31. Mr. Harvey recognised that the prescribed minimum area of chauks was too low, that the open space should be entirely open to the sky and free from encroachments and that the area should be proportionate to the height ; and following the Calcutta Bye-laws he recommended that—

"(*a*) The whole of at least one side of every room should be an external wall abutting on the open air or should abut on an interior open space.

"(*c*) Every interior open space referred to in (*a*) above should have a minimum superficial area of one-fourth § of the aggregate floor area of all the rooms abutting thereon and a minimum width of 8′, and should be open to the sky and free from any erections or encroachments of any kind. The height of any face of a dwelling abutting on such open space should not exceed twice ¶ the width of the open space

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* *Vide* Appendix D.
† *Vide* Appendix D.
‡ *Vide* Appendix D.
§ The B. C. M. Act, s. 348 (*e*), makes this one-tenth.
¶ This is the 63½° rule.

measured from such face to the opposite face; but when a dwelling-house has more than two storeys, the storeys above the second should not be taken into account in applying this rule as to height, if they are built on not more than two sides of the house."

32. *As in the case of rear and side open spaces, the legislators of* 1905 *took no notice of this recommendation, leaving the Municipality to deal with the matter in bye-laws. The Corporation took another* 5 *years to pass the bye-laws and then in* 1910 *merely reproduced in Bye-law* 41 (*1*) (*b*),* *the provisions of the original Act and met Mr. Harvey's recommendations only to the extent of abolishing the* ultra vires *provisions of old Bye-law* 31 *which permitted encroachment on the open space.*

33. *Since* 1910 *quite a large number of inadequate chauks have been constructed in new or rebuilt buildings outside Improvement Trust Estates, and the longer the amendment of Bye-law* 41 *is deferred the more such insanitary chauks will be constructed and the greater will be the cost of removing or enlarging them.*

34. Now there is no reason why rooms lighted and ventilated from a chauk should not be required to satisfy as high a standard of lighting and ventilation as rooms lighted from front, rear or side open spaces: rather the standard should be higher, since the air in chauks is not reached by air currents along streets and rear open spaces and is apt to become stagnant. So in this one matter of chauks the Trust, instead of following as usual a middle course between Mr. Harvey's proposals and Municipal methods, go rather farther than Mr. Harvey. *They make* 10′ × 10′ *the absolute minimum chauk area and they simply apply the same* 63½° *light-plane rule to rooms abutting on chauks as they apply to all other rooms.*

35. The effect of this is shown in Appendix B, paragraph 4, Diagrams Nos. 12 to 14. Generally the chauk must be at least half as broad as it is high; but if, as appears to be customary in Calcutta, the chauk is built with two faces higher than the other faces, then the breadth must be at least half the height of the *higher* faces, otherwise the ground floor rooms on the lower side will not get direct light at an angle of 63½° (*vide* Diagram No. XIII).

36. It is unnecessary to elaborate the chauk rules by prescribing that the minimum superficial area should be one-fourth, as Mr. Harvey proposed, or one-tenth, as the Act and the Municipal bye-laws have it, of the aggregate floor area of the rooms abutting thereon: because the 63½° rule brings sufficient light to the exterior wall of the room, and the Trust's rule prescribing that the window area in that exterior wall shall be not less than one-fourth of the wall area and not less than one-fifteenth of the floor area ensures sufficient penetration of the light into the interior of the room. *The Municipality will therefore do well to adopt the Trust's* 63½° *light-plane rule not only for side open spaces but for interior chauks.*

(*d*) *Window area.*

37. The Municipal Act, section 348 (*1*) (*j*),† requires that every room shall have one wall abutting on an open space and provided with doors and windows aggregating in area at least one-fourth of the area of the wall; *but apart from the fact that the open space outside the wall may be narrow, dark and foul, there is no prescribed relation between the window area and the floor area, so that in deep narrow rooms only the end nearest the window is properly lighted, while the remainder is commonly partitioned off, after the completion certificate is given and the Municipal Inspectors no longer have the building under supervision, into separate tenements which get next to no light or ventilation.* Recognising this evil, Mr. Harvey recommended that doors should be left out of account and that windows or gratings equal to $\frac{1}{10}$th of the floor area of the room should be enforced; but outside Improvement Trust Estates this recommendation, like most of Mr. Harvey's recommendations on the subject of lighting and ventilation, went unheeded. *There has been no change in the Municipal Act and bye-laws and outside Improvement Trust Estates the defects against which the recommendation was directed have gone on increasing in number with the increase in buildings all through these last* 12 *years.*

38. Recognising that it is useless to bring light and air merely to the outside wall of a room used for human habitation without taking measures to secure adequate penetration of this light and air into the interior of the room, *the Trust supplement their light and air-plane rules by rules providing that every such room shall have a wall abutting on a* 63½° *light-plane which has a permanently open air space above it, and requiring* (*i*) *that at least one-fourth of the area of such room wall shall be occupied by doorways, windows or other openings for the admission of light and air, and* (*ii*) *that the aggregate area of all such openings into the room from such light-planes shall be at least equal to one-seventh of the floor area and shall include an area at least equal to* $\frac{1}{15}$*th of the floor area through which light will still penetrate when the doors are shut.*

39. The first requisition merely amplifies section 348 (*1*) (*j*)‡ of the Bombay City Municipal Act by limiting the openings which count towards the legal minimum

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* *Vide* Appendix D. † *Vide* Appendix D. ‡ *Vide* Appendix D.

to those which abut on a 63½° light plane which has a permanently open space above it, whereas under the Municipal Act openings into a dark 4′ side gully would all count. The second requisition prevents the construction of very deep rooms, the far end of which can never be adequately lighted from a window that satisfies the first requisition only, even if the 63½° rule is fully satisfied. The difference between the Municipal by-laws and the Trust by-laws is illustrated in the case of the 10 × 10 × 30 ground floor room in a house 40′ high shown in Diagram No. XIV. The Municipality would have to pass a plan showing this room provided with a solid wooden door of ($6\frac{1}{4}' \times 4' =$) 25 square feet in the side *a. b.* (even if the room had no other opening for admission of light and air and even if it were 50′ deep) because section 348 (*l*) (*j*)* is complied with, but under the Trust's requisition (ii) at least ($\frac{30 \times 10}{7} =$) $42\frac{8}{7}$ square feet out of the 100 square feet in wall *a. b.* would have to be taken up with doors and windows and ($\frac{30 \times 10}{15} =$) 20 square feet would have to be glass or open area through which light could obtain ingress when the door is shut. Any openings there might be in the wall *a. d.* would be excluded from this measurement, because the open space outside is too narrow to allow of the 63½° light plane rule being satisfied; *so in addition to the door which is alone required by Municipal by-laws the owner would under Trust by-laws have to provide a 4′ × 5′ window in the wall a. b.* The Trust would also insist on gratings for ventilation near the top of the wall *c. d.*

40. The Trust rule is rather less stringent than Mr. Harvey's, in so far as the window area is required to be $\frac{1}{15}$th, not as Mr. Harvey proposed $\frac{1}{10}$th, of the floor area: but combined with the light and air plane rules it is found to ensure a sufficiently high standard of lighting and ventilation, and it may therefore be safely adopted by the Municipality.

Application of by-laws to existing buildings.

41. Most of the remainder of Mr. Harvey's recommendations that I have not already referred to were adopted wholly or partly in the 1905 Act or the 1910 by-laws, and it is therefore unnecessary to refer to them here. The only question left for discussion is the general question dealt with in paragraph 3 of Mr. Harvey's covering letter† as to how far new rules should be enforced in respect of buildings on sites that had already been built on before the rules were passed. Mr. Harvey recommended that the new regulations should be applied in their entirety to all newly erected buildings and to all buildings undergoing substantial reconstruction after removal of a certain proportion of posts, beams and walls, and that in other cases the general rule should be that all alterations and additions should be carried out in accordance with the Act and by-laws, and should not be such as to cause any contravention of the same, exception being made in the case of *necessary repairs not affecting the position or dimensions of the buildings.*

42. For convenience of reference, I will denominate the three classes of work to which Mr. Harvey referred as (1) substantial alterations, (2) necessary repairs, and (3) other alterations and additions. Under the original Act of 1888 the Commissioner had very little control over existing buildings or buildings newly erected on sites on which there had at any previous time been buildings. *The owner could and still can evade all the building regulations under Chapter XII, even when entirely reconstructing his building, by doing the work piecemeal.* Mr. Harvey recommended that, when a building was undergoing substantial alteration, the opportunity should be taken to bring the whole building into conformity with the Municipality's up-to-date building regulations. But because it would be oppressive to require the extensive alterations involved by compliance with up-to-date building regulations to be carried out all over the building, when the owner was contemplating only a few minor alterations in a small part of a building, he recommended that in the case of such minor alterations—class (3)—compliance with the building regulations should be enforced only in respect of the alterations themselves, and not in respect of the part of the house left untouched; while for alterations of the 2nd class—necessary repairs—he thought that the owner might be left to his own devices, free from Municipal regulations.

43. *So far very little has been done to meet these recommendations: all that the amending Act of* 1905 *did was to withdraw the previous exemption of new buildings on sites that had ever before been built on from the requirements of section* 348.

44. *The By-laws of* 1910 *contain the following clause:—*

> "*These by-laws shall have no application to any works to be done on or to any already existing building unless and except to the extent to which such work is such as is described in section* 342‡ *of the Act.*

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* *Vide* Appendix D. † *Vide* Appendix C. ‡ *Vide* Appendix D.

This, taken with the definition* of " construction work on a building " has the effect of combining Mr. Harvey's classes (1) and (3) under the less stringent control that Mr. Harvey proposed for class (3) only, so that, however much a building may be altered or added to, the by-laws can only apply to the altered part or the new part. In so far as there may be alterations not of the nature of additions, the new by-laws have effected some improvement; *but an immense amount of harm has been done in the past and is still being done and will yet be done by allowing additions, however sanitary in themselves, to be made to old buildings which do not comply with up-to-date standards of sanitation, especially when the addition takes the shape of a new storey.*

45. In all the insanitary areas that have been " represented " to the Trust by the Municipal Commissioner, a large number of additional storeys have been permitted since the date of the representation, and thus the cost of acquisition has been immensely increased: but that is by no means the full extent of the harm done. *Throughout the congested areas of Bombay, whether " represented " or not, there have been new storeys added to very many houses in the last* 12 *years, and a visit to these congested areas or even a study of Diagrams Nos.* VIII, IX, X *and* XA *will soon make the enquirer realise that however serious the evils resulting from congestion of houses of one or two storeys on building areas may be, those evils are greatly intensified when additional storeys are added to these houses, and the dark, narrow, foul gullies and the rooms abutting on them are thus made darker and fouler still.*

46. Some idea of the extent to which this evil has grown may be gathered from a study of the models in the Improvement Trust Office showing the houses, of which Diagram No. IX gives the present ground plan, and Diagram No. VIII the ground plan as in 1872.

47. The only recommendation in Mr. Harvey's report to which I am strongly opposed is the recommendation that additions to buildings should be brought under the secondary control of class 3. *I think it is of the utmost importance that, following English precedents, the by-laws should be at once altered so as to provide that no addition to any building shall be allowed unless the whole building is altered so as to satisfy the requirements of the new by-laws, at any rate as regards exterior and interior open spaces, dimensions of rooms, windows and staircases and materials of floors, walls and roofs.*

48. To encourage owners to make the necessary alterations at an early date, I would, in cases of large straggling houses, allow any substantial part of the house that can be cut off from the rest of the house to be treated as if it were a separate house for the purposes of this rule.

49. As to alterations, I agree with Mr. Harvey that there should be a distinction between substantial alterations involving a large part of the building and minor alterations; but his method of drawing the line admits of evasion, just as the wording of sections 337 and 342 † of the Act does, by the simple device of piecemeal alterations of a house. *It is therefore necessary to find some other method of drawing the line between class* (1) *and class* (3), *substantial and minor alterations. I think it will be best to make a list of alterations that should be placed in the category of substantial alterations, somewhat similar to the list in Rule* 52‡ *of Schedule* 17 *of Calcutta Municipal Act: but here, to avoid hardship, I would take the room, not the house, as the unit, and require that when substantial alterations are made in any room the whole room shall be so altered as to bring it into conformity with all the latest building regulations.*

50. The Trust of course have a less difficult problem than the Municipality to deal with, because they have very few old buildings; they are therefore able to apply their rules in their entirety to all cases, *the only exception being the cases in which their plots have old house sites outside their estates abutting on them. In such cases, as explained in paragraphs* 18 *and* 19, *they allow temporary deviations from the* 63½° *standard in anticipation of open margins being ultimately provided in the plots outside their estates; and it is to be hoped that the Corporation will decide to adopt the same policy in pursuance of the recommendations of the Committee appointed to revise their by-laws.* This will go a long way towards effecting the necessary improvements, especially if the Trust co-operate by acquiring the land required to make 4′ gullies between rows of houses 20′ broad as contemplated in their new Undria Street Improvement Scheme. The compensation owners will get for this land will serve as a contribution from the public purse towards the cost of providing the house with a rear open space and will be justified by the consideration that the provision of adequate rear open space between rows of buildings and incidentally of facilities for conversion of privies into water closets is thereby expedited, to the great benefit of public health, whereas if each owner is allowed to defer providing his rear open space until he is making substantial alterations in his house, it will be many years before any improvement of a whole row of buildings can be made.

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* *Vide* Appendix D. † *Vide* Appendix D. ‡ *Vide* Appendix D.

Simplifications.

51. It would add greatly to the simplicity of the Municipal by-laws if it were the law, as it is in many towns in England, *that no part of a building may exceed in height the breadth of the broadest road on which it abuts.* This would do away with all the complications due to setting back the upper floors of buildings (*vide* para. 11 and proviso* to section 349-B of the Municipal Act) and it would prevent the creation of any more of the eyesores which one finds all over the City in consequence of the sky line being broken by projecting heads of roof staircases, banglis and the like.

52. There will be a further gain in simplicity, if a formal private covenant between two parties to keep any area as permanent open space can be replaced by a joint declaration made before the Municipal Commissioner, recorded by him in a special register and on his maps, and enforced in the course of proceedings under the Bombay City Municipal Act, Chapter XII, in connection with building notices.

53. Another suggestion towards simplifying the relations between neighbours is that a simple affidavit by the owner (A) of a property to the effect that he has no easements over his neighbour B's property should suffice to save B's property from the creation of such easements in future just as if B, instead of obtaining the affidavit, had put up a hoarding along the boundary between the two properties.

Recapitulation.

54. To recapitulate,—I have pointed out that the insanitary condition of the congested areas in Bombay is largely due to defects in lighting and ventilation of houses; that the amendments in the Bombay City Municipal Act and by-laws which Mr. Harvey suggested in 1901, with a view to removing these defects, though considered when the Act was amended in 1905 and when the new by-laws were passed in 1910, have not yet been carried out, and that consequently evils resulting from these defects have gone and are still going from bad to worse in the areas in question in the 12 years that have elapsed since Mr. Harvey first brought the matter to the notice of the Municipality. Following in the main Mr. Harvey's recommendations, I have recommended certain remedies for the several defects, the chief of which are as follows :—

Defects in the Act and By-laws.	Evils resulting therefrom.	Remedies suggested.
Para. 9.—Want of a legal limit to the height of a building that does not abut on any street.	*Para.* 9.—High buildings erected in higgledy-piggledy disorder shutting out light and air from neighbouring buildings.	*Para.* 10.—Enact that such buildings shall not be extended until the limits of the streets on which they are ultimately to abut have been determined. Enforce section 348 (*b*) to prevent the erection of any more such buildings.
Para. 11.—Want of a legal limit to the height of buildings in the rear.	*Para.* 11.—Buildings gradually rising towards the rear in setbacks erected so as to shut out light and air from their neighbours.	*Para.* 11.—The Municipality should at once adopt the Trust's rear air plane rule and a corresponding front air plane rule in their building by-laws.
Para. 12.—Want of a provision requiring every house to be provided with rear open spaces.	*Para.* 13.—Foul narrow gullies between the backs of buildings.	*Para.* 17.—For congested areas the Municipality should at once adopt the Trust's rear air plane rule and (*para.* 20) for other areas the Calcutta rear air plane rule.
Para. 22.—Inadequate provision in Act and by-laws for side open spaces for lighting and ventilation of side rooms.	*Para.* 22.—Long foul narrow gullies between high houses the only means for lighting and ventilating side rooms abutting on them.	*Para.* 28.—The Municipality should adopt the Trust's 63½° light plane rule.
Para. 32.—Inadequate provision in Act and by-laws for securing lighting and ventilation of interior rooms from chauks.	*Para.* 29.—Far too small chauks constructed only to serve as rubbish shoots.	*Para.* 36.—The Municipality should adopt the Trust's 63½° light plane rule.

**Vide* Appendix D.

Defects in the Act and By-laws.	Evils resulting therefrom.	Remedies suggested.
Para. 37.—Want of a prescription as to the relation between the window area and the floor area.	*Para.* 37.—Deep narrow rooms inadequately lighted are partitioned off into separate tenements, of which only the one nearest the exterior wall gets any light or air.	*Para.* 40.—The Municipality should adopt the Trust rule (*para.* 38) requiring every room to be lighted by windows opening on to an adequate exterior open air space with openings equal to at least $\frac{1}{7}$th of the floor area.
Para. 42.—Inadequate control over alterations of old building.	*Paras.* 44 & 45.—Old buildings reconstructed piecemeal are not subject to new by-laws, with the result that the original defects remain unaltered: while new storeys added to old buildings, though themselves subject to new by-laws, aggravate the evils resulting from inadequate lighting and ventilation of the old buildings below them.	*Para.* 47.—The by-laws should provide that no addition to an old building shall be allowed unless the whole building is altered so as to satisfy the requirements of the new by-laws, and (*para.* 49) that when substantial alterations are made in any room, the whole room shall be so altered as to bring it into conformity with all the latest building regulations.

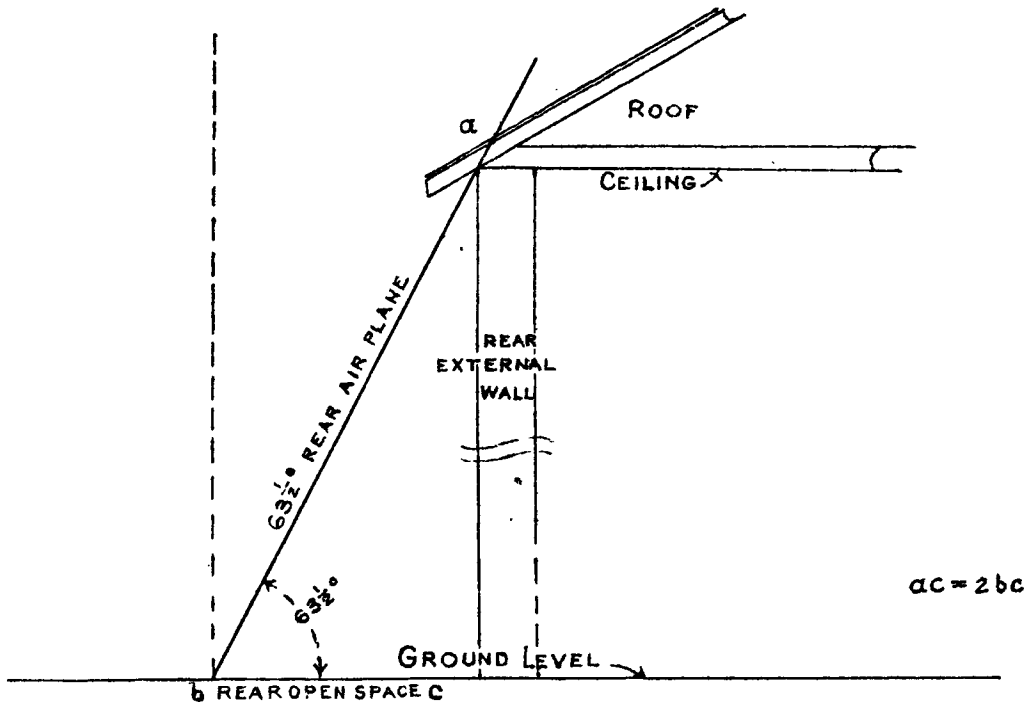
APPENDIX A.

DIAGRAMS I TO XIV

ILLUSTRATING MAIN NOTE.

DIAGRAM No. I

SHEWING THE 63½° REAR AIR PLANE



NOTE:- THE AIR PLANE RULE REQUIRES THAT THERE SHALL BE NO ERECTION ENCROACHING ON THE AIR SPACE ABOVE THE AIR PLANE TO THE RIGHT OF THE VERTICAL DOTTED LINE.

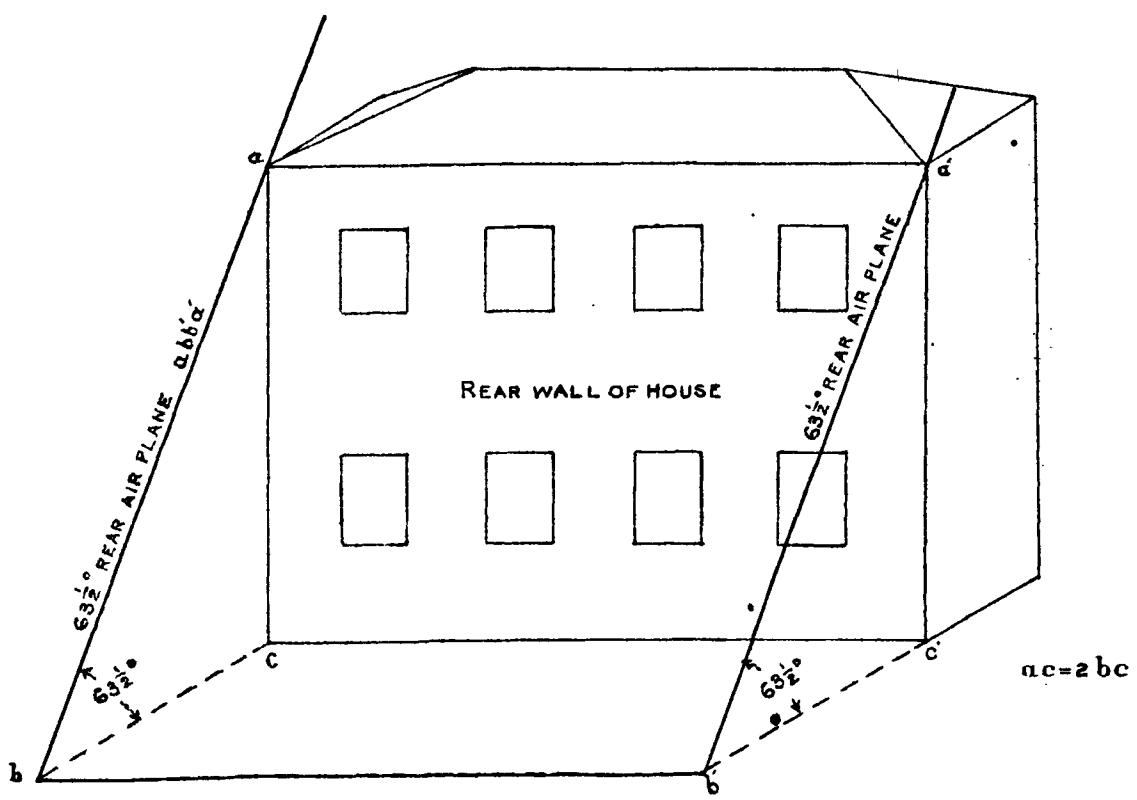
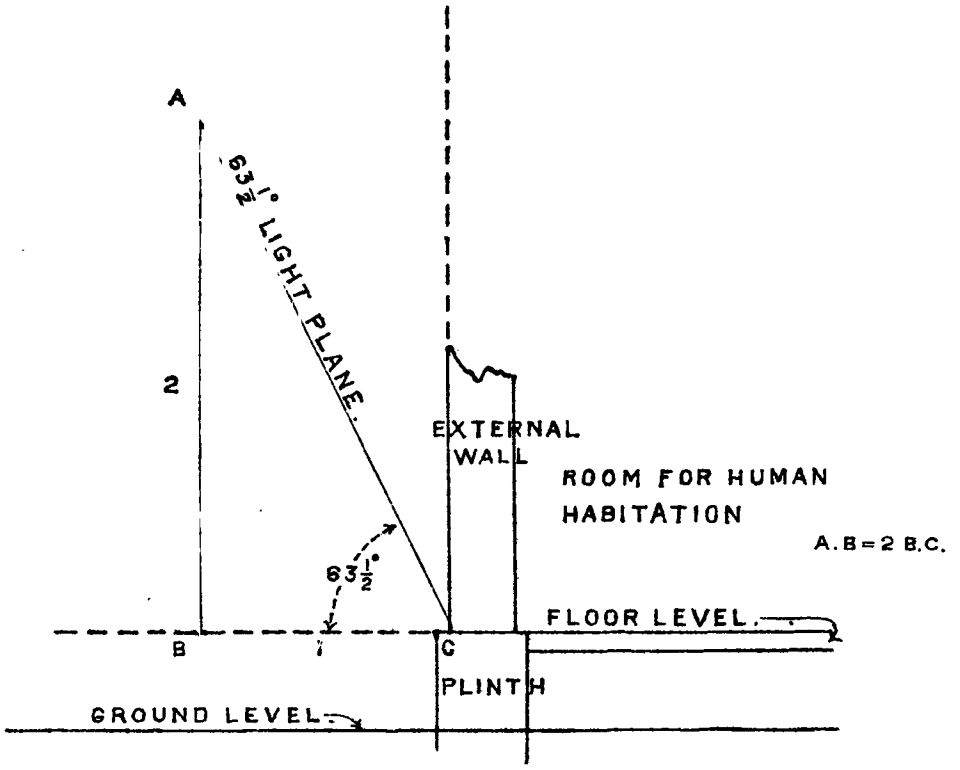
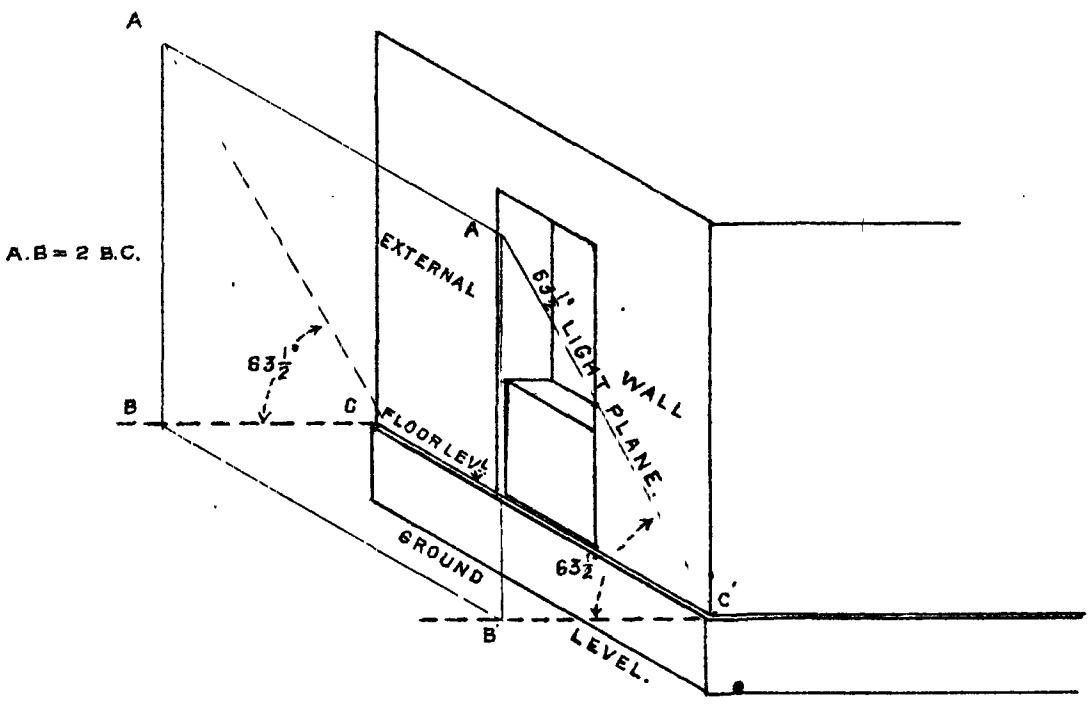


DIAGRAM No. II

SHEWING THE $63\frac{1}{2}^{\circ}$ REAR LIGHT PLANE



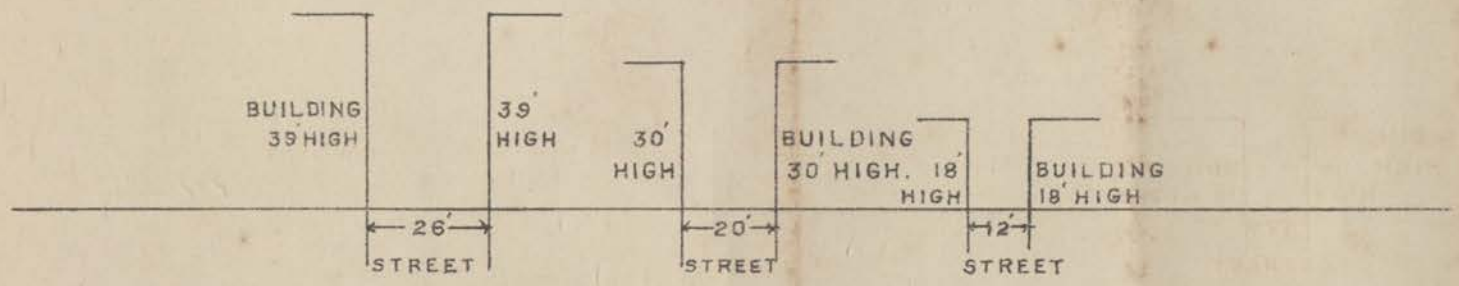
NOTE :- THE LIGHT PLANE RULE REQUIRES THAT THERE SHALL BE NO ERECTION ENCROACHING ON THE AIR SPACE VERTICALLY ABOVE THE LIGHT PLANE TO THE LEFT OF THE VERTICAL DOTTED LINE.



THE LIGHT PLANE EXTENDS AD INFINITUM FROM CC' UPWARDS BETWEEN CA & C'A'

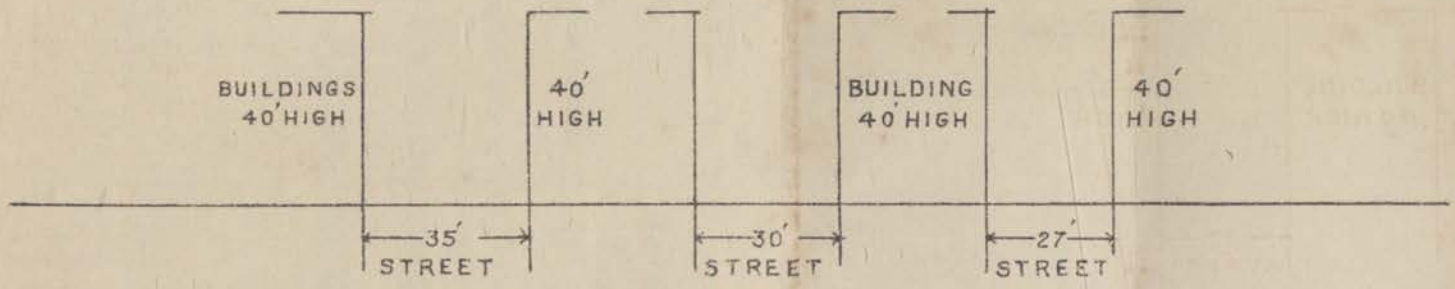
DIAGRAM No. III

SHEWING MAXM. HEIGHTS OF BUILDINGS ON STREETS OF VARIOUS WIDTHS UNDER B.C.M. ACT SECTION 349 (VIDE PARA 9)



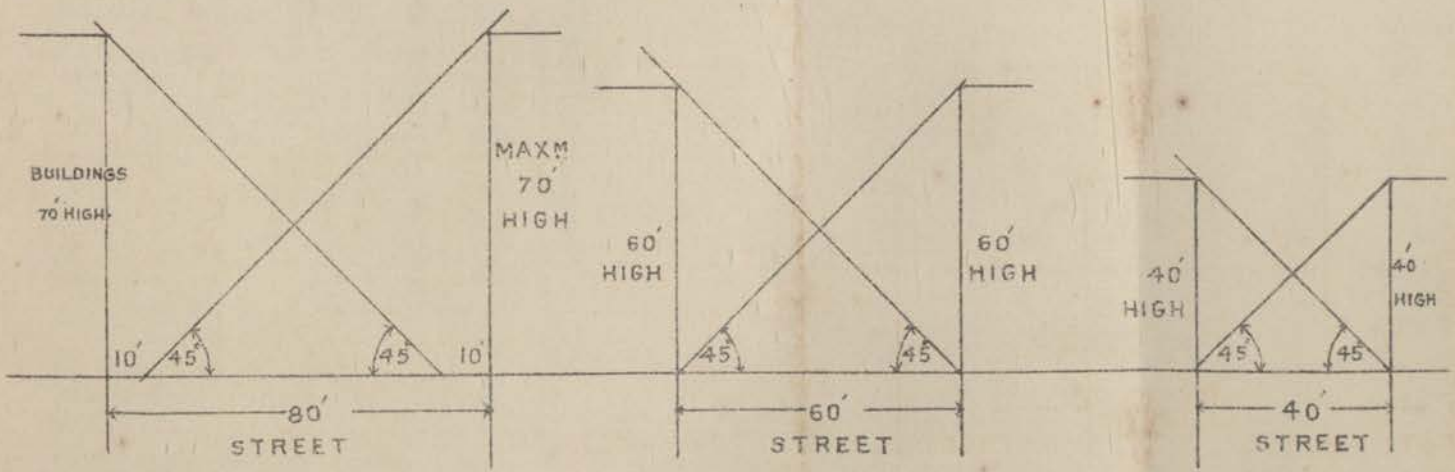
(i) STREETS 26' OR LESS IN WIDTH.

MAXM FRONT HEIGHT OF HOUSE = 1½ TIMES WIDTH OF ROAD.



(ii) STREETS UNDER 40' BUT OVER 26' WIDE.

MAXM FRONT HEIGHT OF HOUSES = 40 FEET.



(iii) STREETS 40' OR MORE IN WIDTH.

MAXM FRONT HEIGHT OF HOUSES = WIDTH OF STREET SUBJECT TO A MAXIMUM OF 70'.

DIAGRAM No. IV

SHEWING THE EFFECT OF PROVISO TO B.C.M.ACT SECTION 349(B)

IN ALLOWING INCREASE IN HEIGHT OF BUILDINGS UP TO

70' BY SUCCESSIVE SET BACKS TOWARDS THE REAR.

VIDE. §. 13

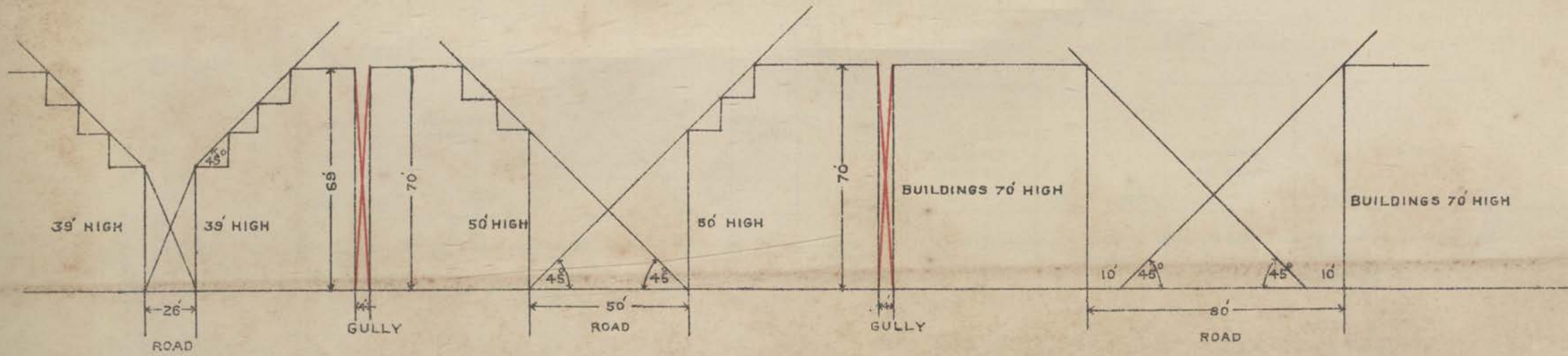


DIAGRAM Nº V

SHEWING EFFECT OF $63\frac{1}{2}^{\circ}$ RULE IN REGULATING EXTENT
OF REAR OPEN SPACE BETWEEN HOUSES OF VARIOUS HEIGHTS

N.B. RED LINES INDICATE REAR AIR PLANES (V. §15/-)

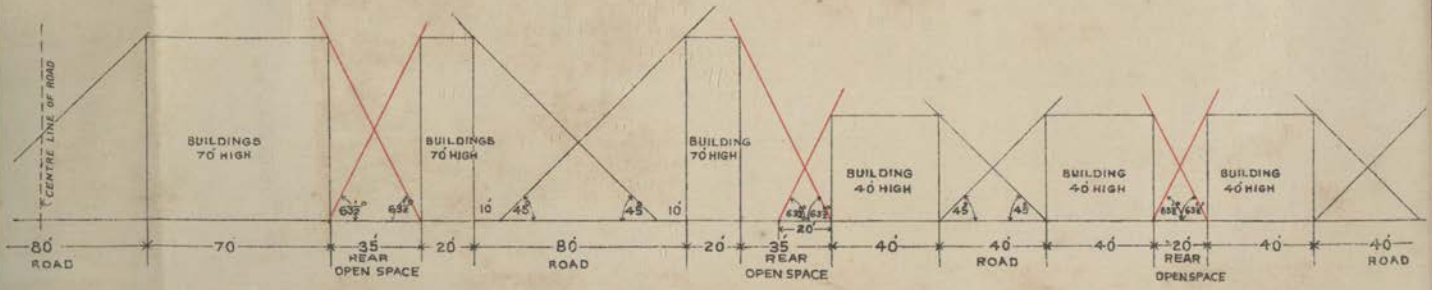
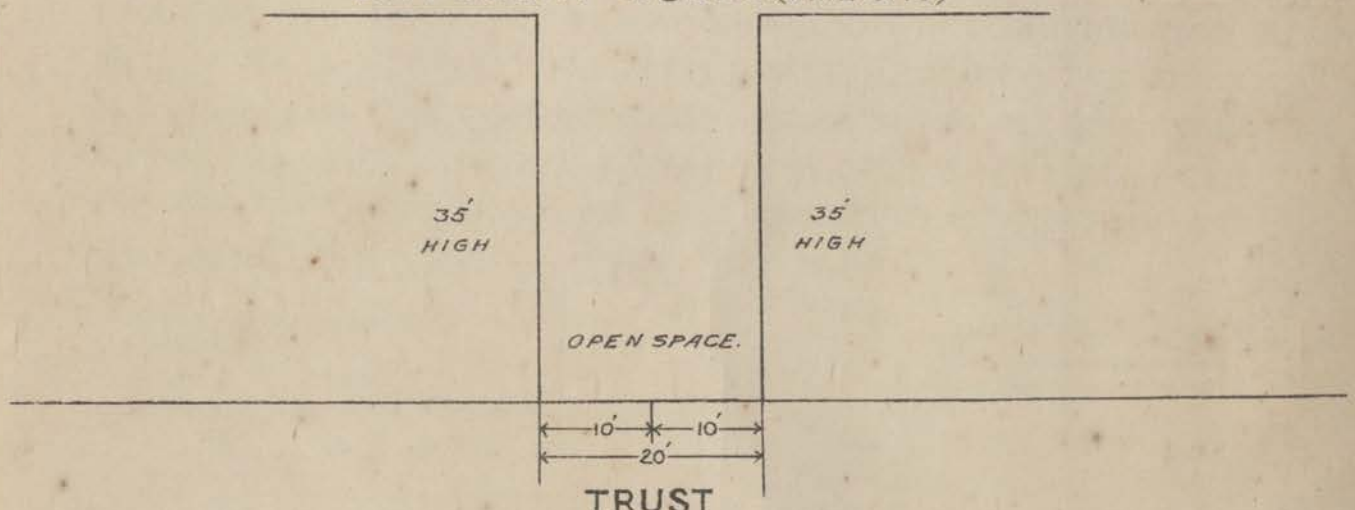
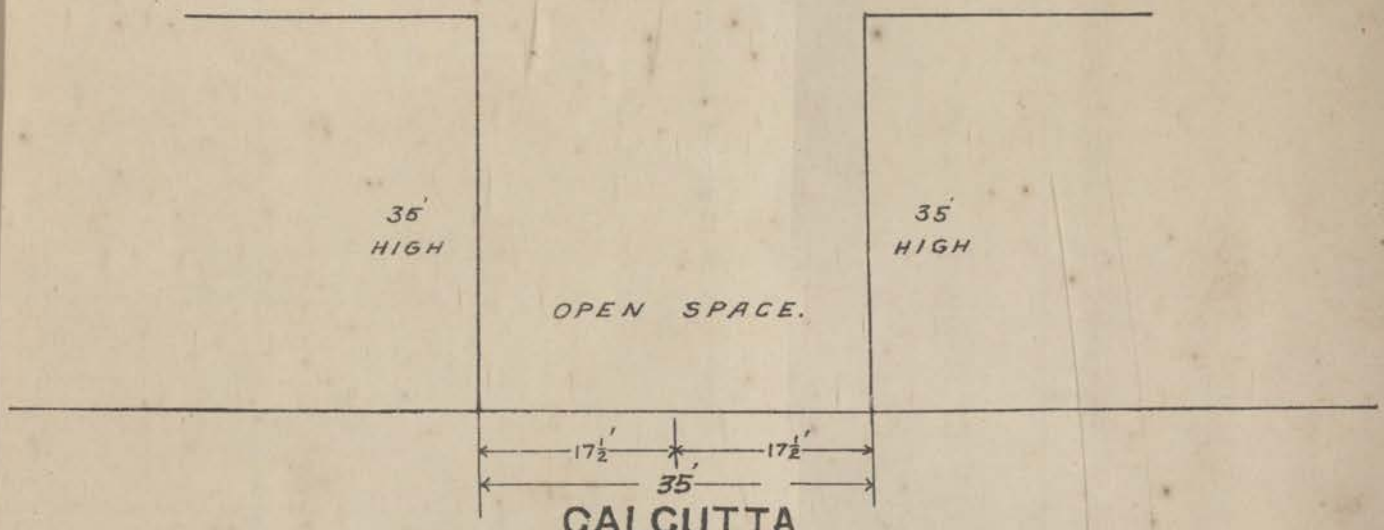


DIAGRAM No. VI

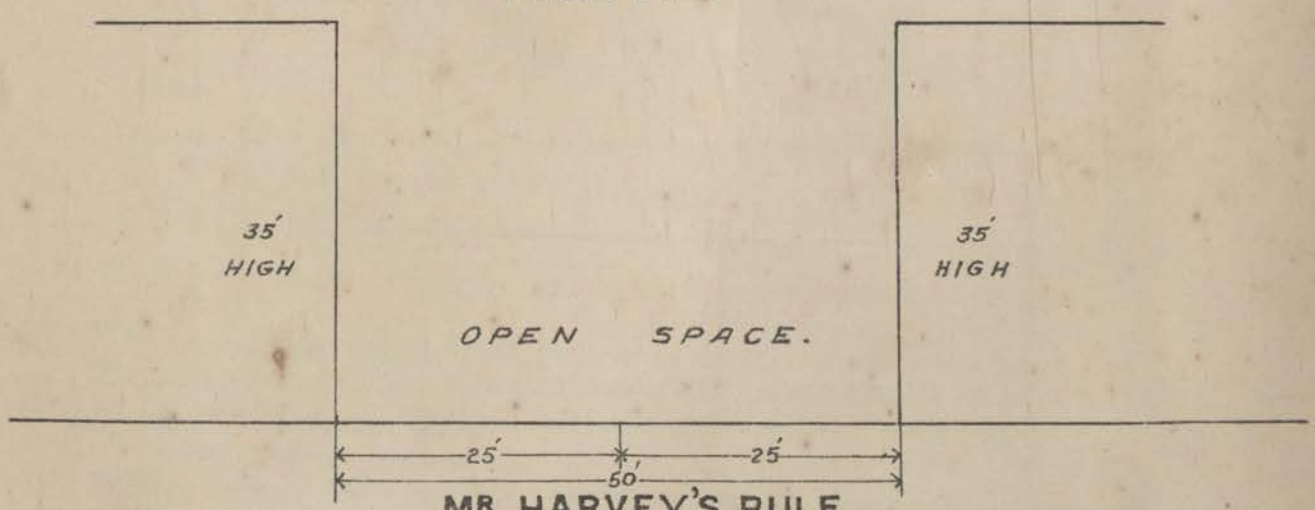
SHEWING MINM REAR OPEN SPACE BETWEEN BUILDINGS 35′ HIGH PRESCRIBED UNDER DIFFERENT RULES (VIDE S. 16)



TRUST



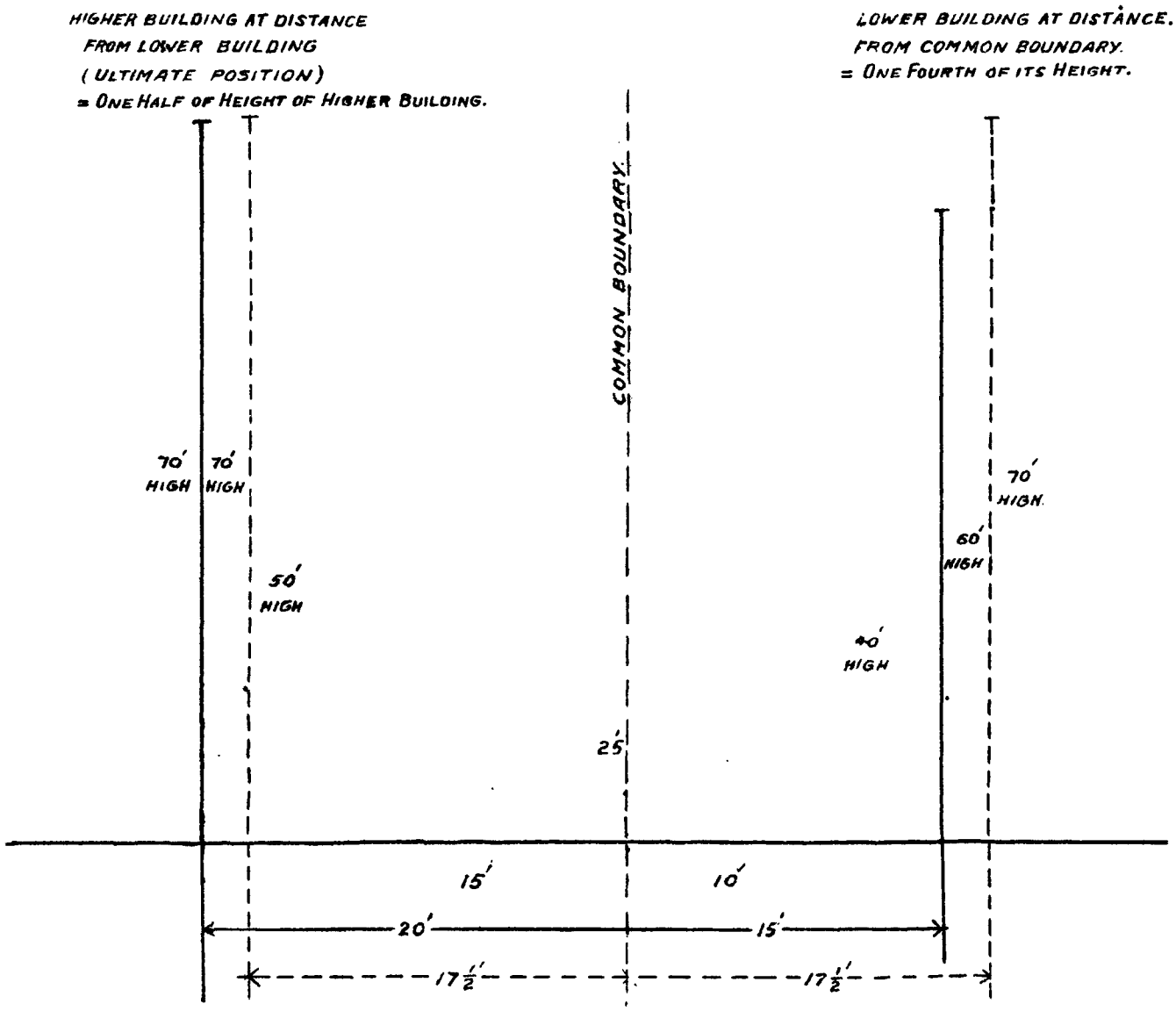
CALCUTTA



Mr HARVEY'S RULE.

DIAGRAM No. VII

TO ILLUSTRATE THE RULE THAT "BUILDINGS ON EITHER SIDE OF A COMMON REAR BOUNDARY SHALL ON RECONSTRUCTION BE SET BACK SO THAT THE OPEN SPACE BETWEEN THE LOWER BUILDING AND THE COMMON BOUNDARY SHALL BE $\frac{1}{4}$ AS BROAD AS THE LOWER BUILDING IS HIGH AND THE OPEN SPACE BETWEEN THE TWO BUILDINGS SHALL BE HALF AS BROAD AS THE HIGHER BUILDING IS HIGH. (VIDE PARA 18)



NOTE. WHEN THE TWO BUILDINGS ARE OF EQUAL HEIGHT EACH WILL BE SET BACK FROM COMMON BOUNDARY TO A DISTANCE = $\frac{1}{4}$ THAT HEIGHT E.G., TWO 70 HOUSES WILL EACH BE SET BACK 17½' FROM COMMON BOUNDARY.

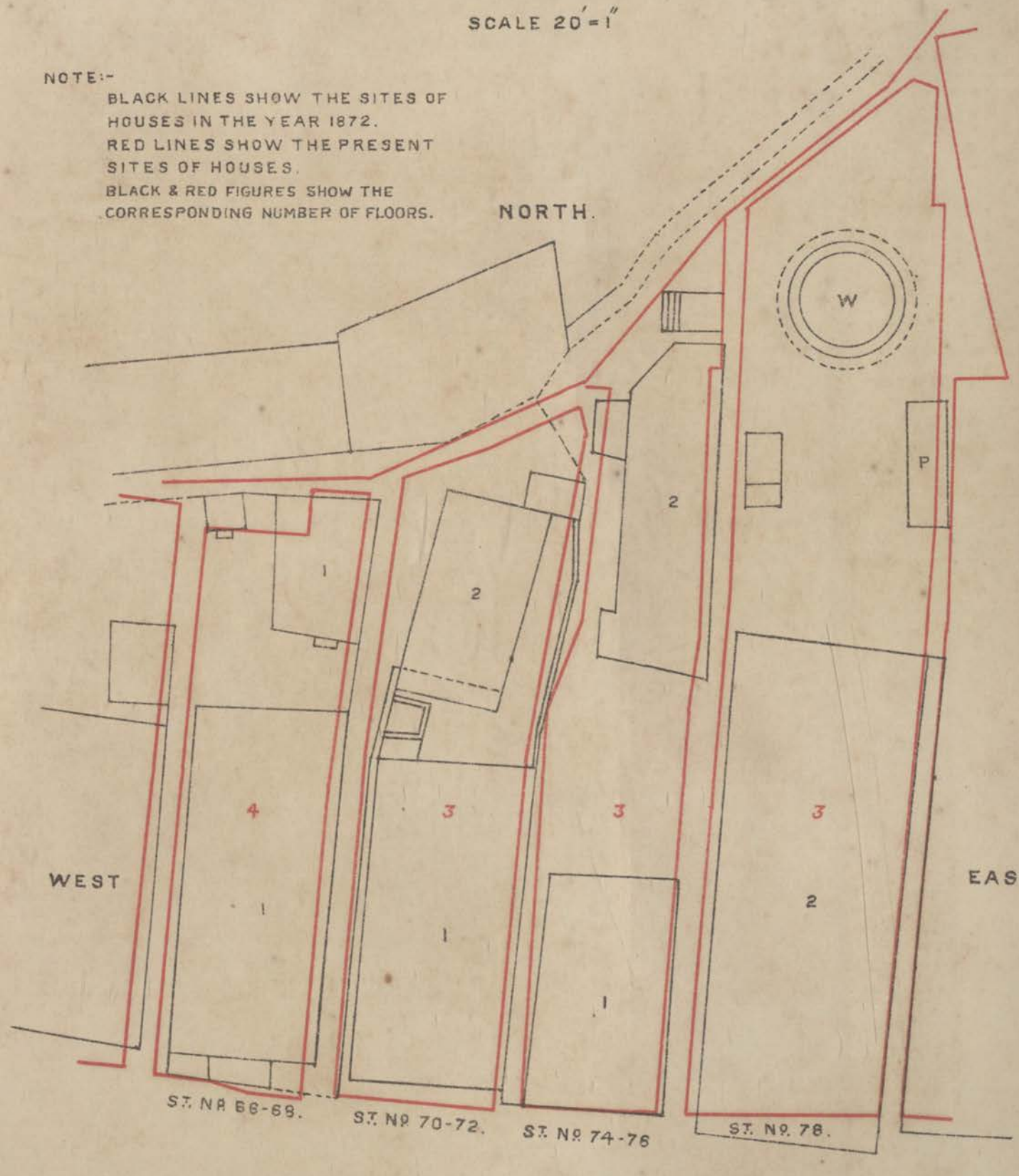
3 CASES SHOWN — IN WHATEVER POSITION THE YELLOW PAIR ORIGINALLY WERE. THEIR FINAL POSITION IS SHOWN IN DIAGRAM: SIMILARLY WITH RED & BLACK PAIRS.

DIAGRAM No. VIII

FOUR INSANITARY HOUSES IN UMARKHADI DISTRICT

SCALE 20'=1"

NOTE:-
BLACK LINES SHOW THE SITES OF HOUSES IN THE YEAR 1872.
RED LINES SHOW THE PRESENT SITES OF HOUSES.
BLACK & RED FIGURES SHOW THE CORRESPONDING NUMBER OF FLOORS.



U M A R K H A D I R O A D

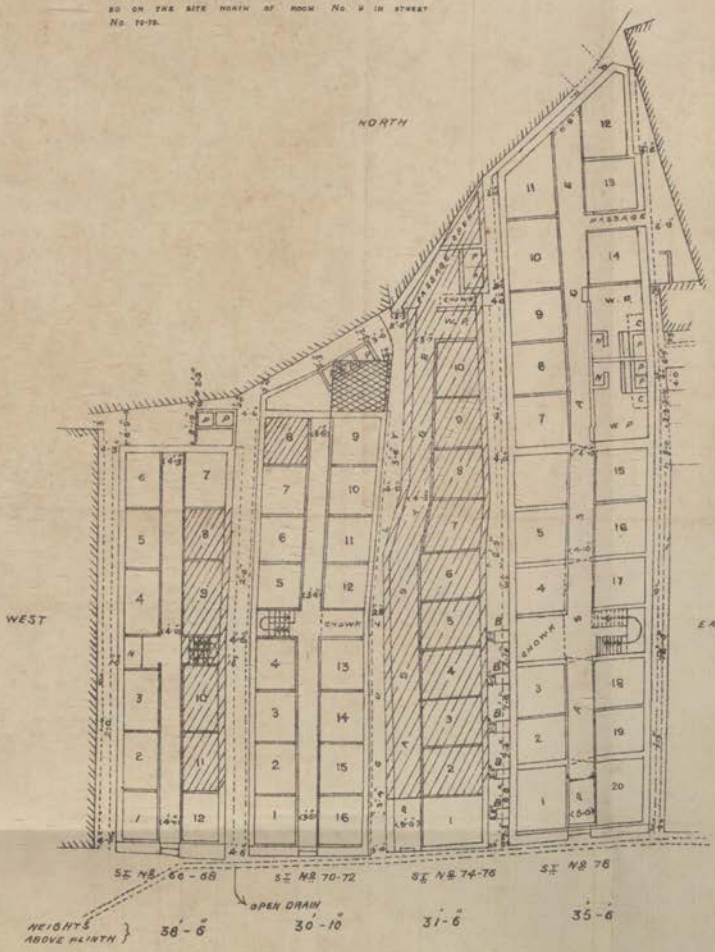
UMARKHADI SCHEME.

PLAN OF FLOORS.

SCALE 20 FEET TO AN INCH.

NOTE :—

HATCHED AREAS INDICATE PROPERTIES WHICH MUST BE ACQUIRED AND CLEARED OF BUILDINGS.
CROSSED HATCHED AREA INDICATES SITE AVAILABLE FOR EXTENSION OF EXISTING BUILDING.
DOTTED LINES INDICATE PROJECTIONS OF EAVES.
B INDICATE GROUND FLOOR BUTTRESS.
AFTER HOUSE No. 74-76 IS REMOVED 17 EXTRA ROOMS CAN BE ADDED ON A NEW FLOOR ABOVE THE ADJACENT ROOM NOS. 2-11 IN STREET No. 76 AND 8 TO 15 IN STREET No. 70-72. FOUR ADDITIONAL ROOMS CAN BE CONSTRUCTED ON THE SITE NORTH OF ROOM No. 9 IN STREET No. 70-72.



Govt. Photozincograph Office, Poona, 1913.

Bombay Improvement Trust

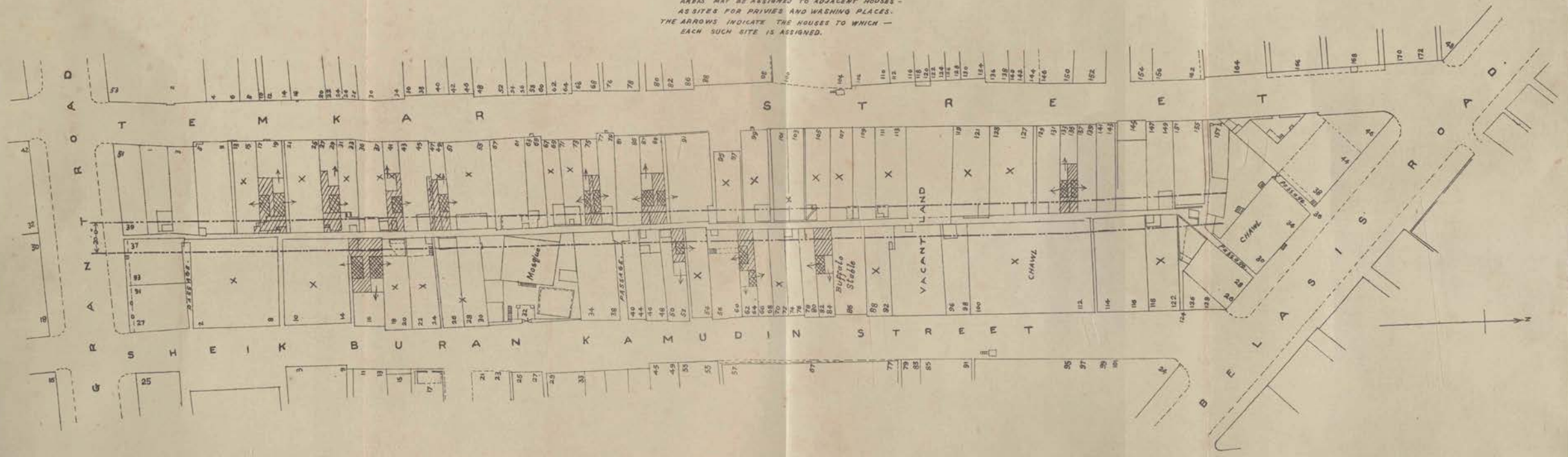
PORTION OF SECOND NAGPADA IMPROVEMENT SCHEME.

PLAN B REFERRED TO IN APPENDIX A § 16

SCALE 40 FEET TO AN INCH.

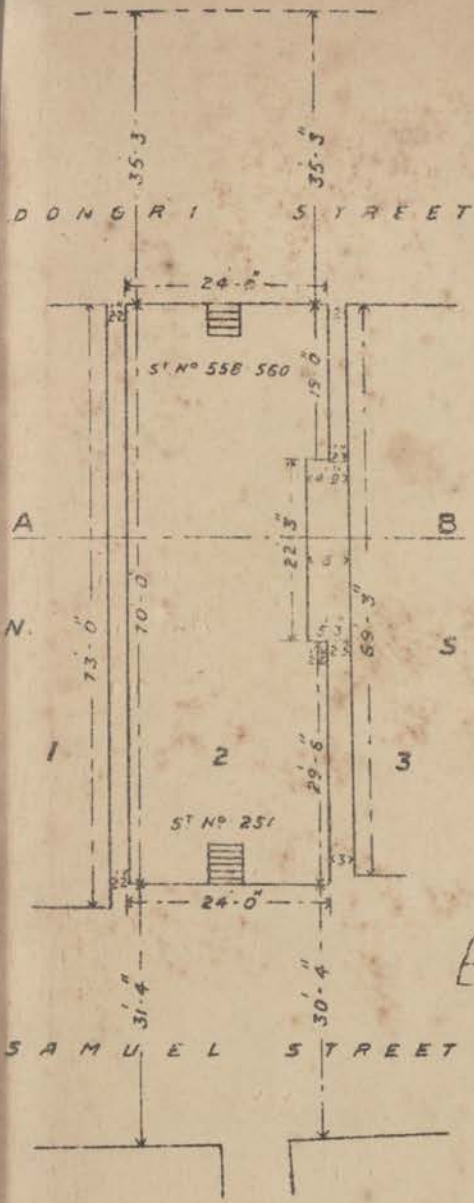
NOTE:—

CROSSES DENOTE SUBSTANTIAL HOUSES.
CHAIN LINES INDICATE THE STRIP 20 BROAD TO BE CLEARED OF BUILDINGS.
HATCHED AREAS ARE THOSE TO BE ACQUIRED AND CLEARED IN ORDER THAT THE CROSS HATCHED AREAS MAY BE ASSIGNED TO ADJACENT HOUSES AS SITES FOR PRIVIES AND WASHING PLACES.
THE ARROWS INDICATE THE HOUSES TO WHICH EACH SUCH SITE IS ASSIGNED.

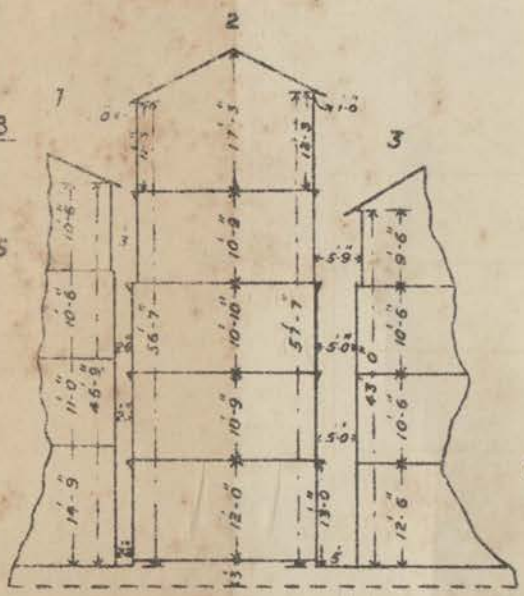


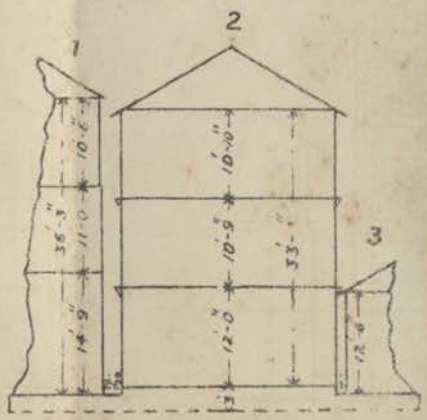
Govt Photozinco Office, Poona, 1909

DIAGRAM Nº X. A.



SCALE 20′ = 1″





SECTION ON LINE A.B.

OF THE HOUSES AS SHOWN IN

LAUGHTON SURVEY SHEET YEAR 1871.

SAMUEL STREET SECTION ON LINE A.B.

SCALE 20 FEET TO AN INCH.

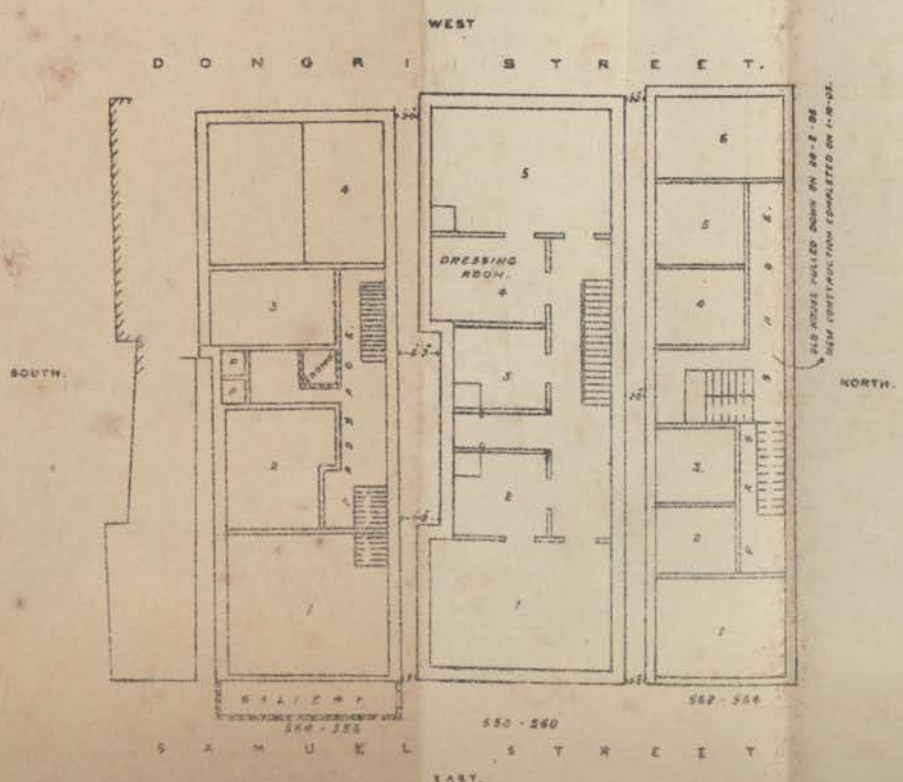


DIAGRAM Nº XI.

SHOWING MINIMUM SIDE OPEN SPACE BETWEEN AN OLD BUILDING 68′ HIGH & A NEW BUILDING 68′ HIGH UNDER VARIOUS RULES.

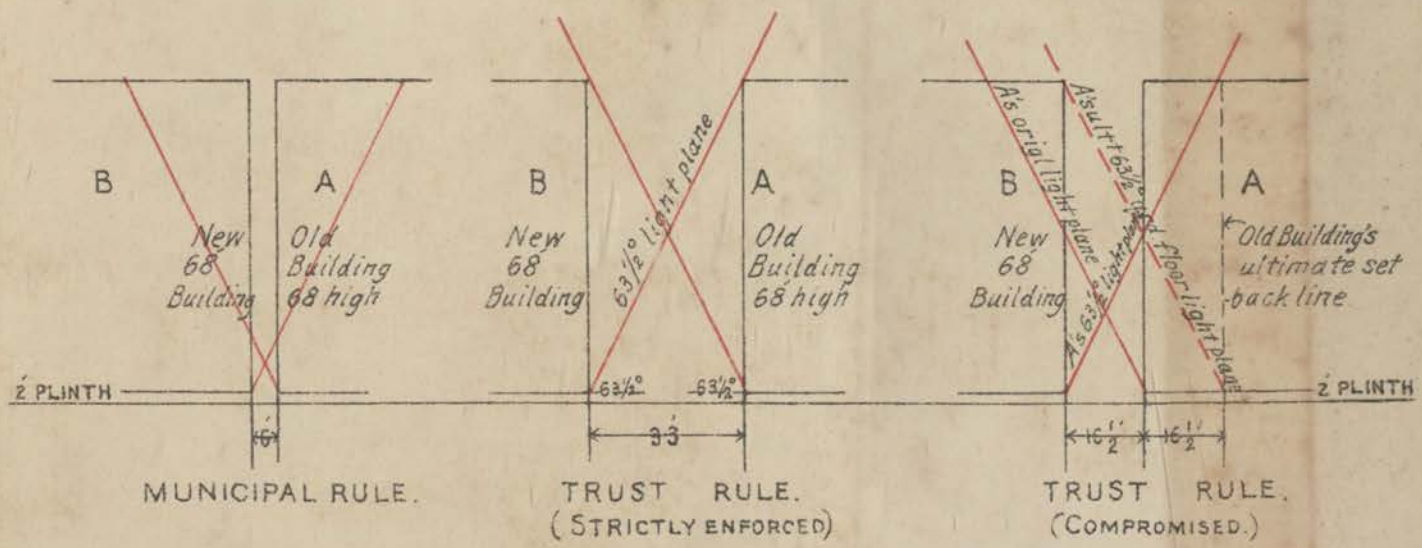
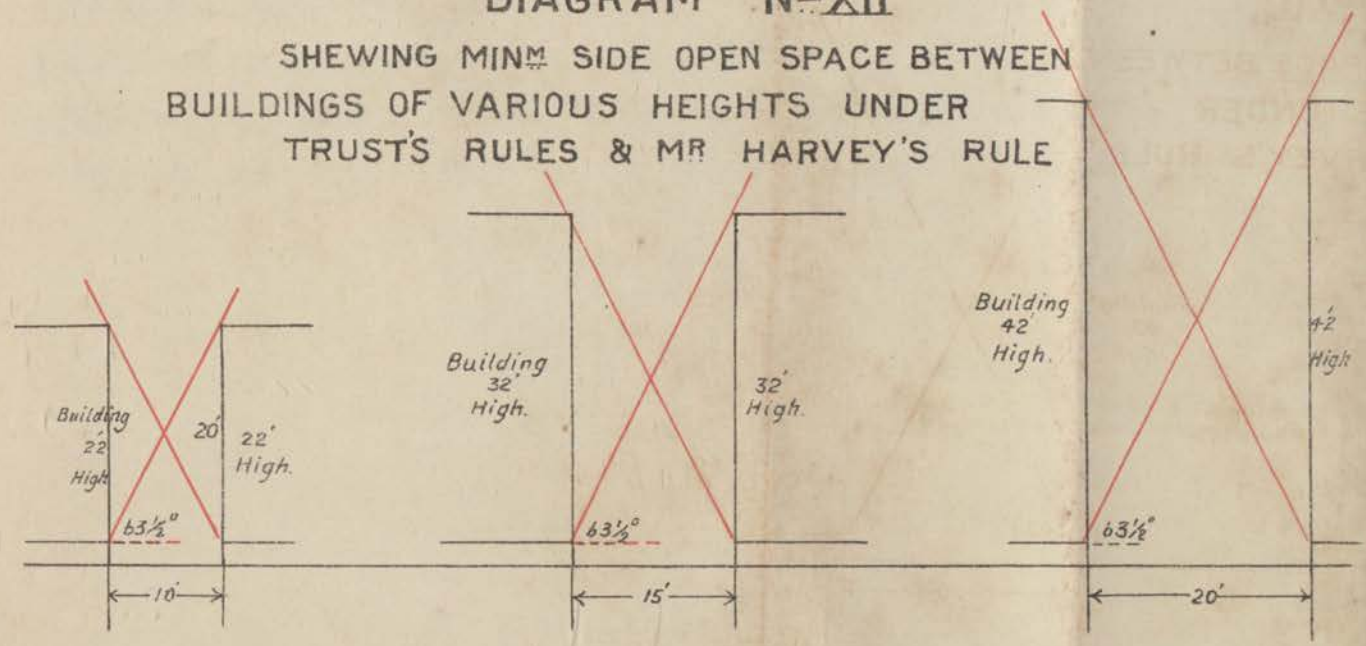
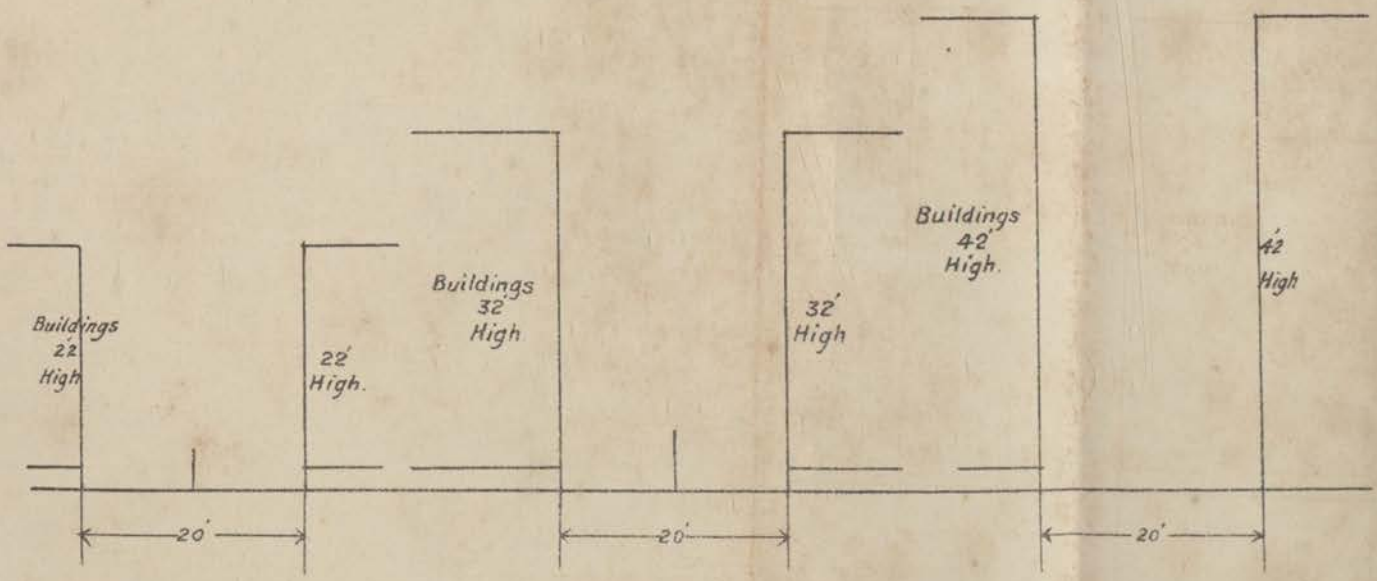


DIAGRAM No XII

SHEWING MINM SIDE OPEN SPACE BETWEEN BUILDINGS OF VARIOUS HEIGHTS UNDER TRUST'S RULES & MR HARVEY'S RULE



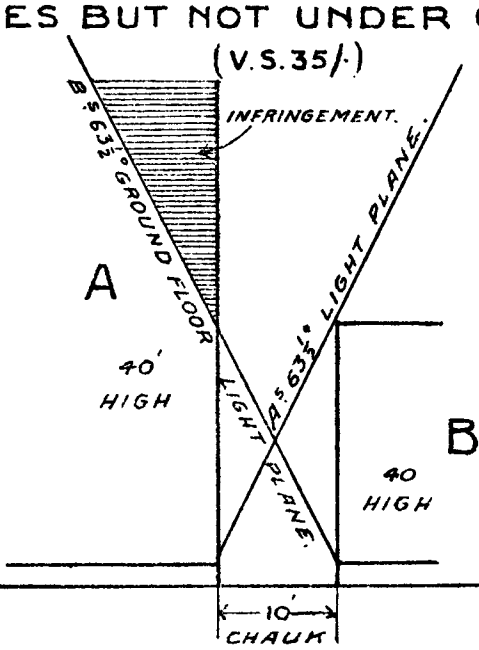
TRUSTS 63½° RULE.



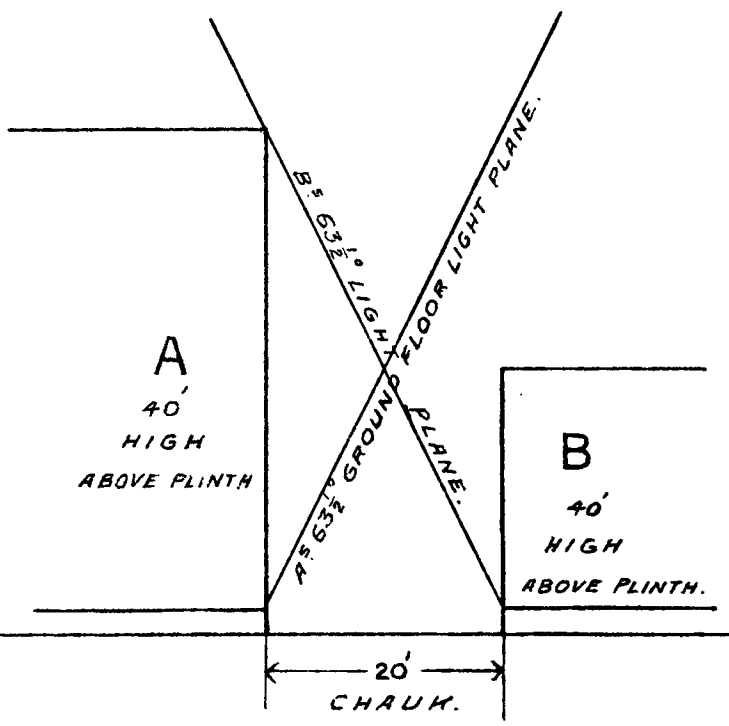
MR HARVEY'S RULE.

DIAGRAM No. XIII

SHEWING HOW IN A CHAUK WITH 40′ BUILDINGS ON ONE SIDE AND 20′ BUILDINGS ON THE OTHER THE GROUND FLOOR ROOMS IN LOWER BUILDINGS SATISFY THE 63½° RULE ON TRUST'S ESTATES BUT NOT UNDER CALCUTTA BY LAWS.



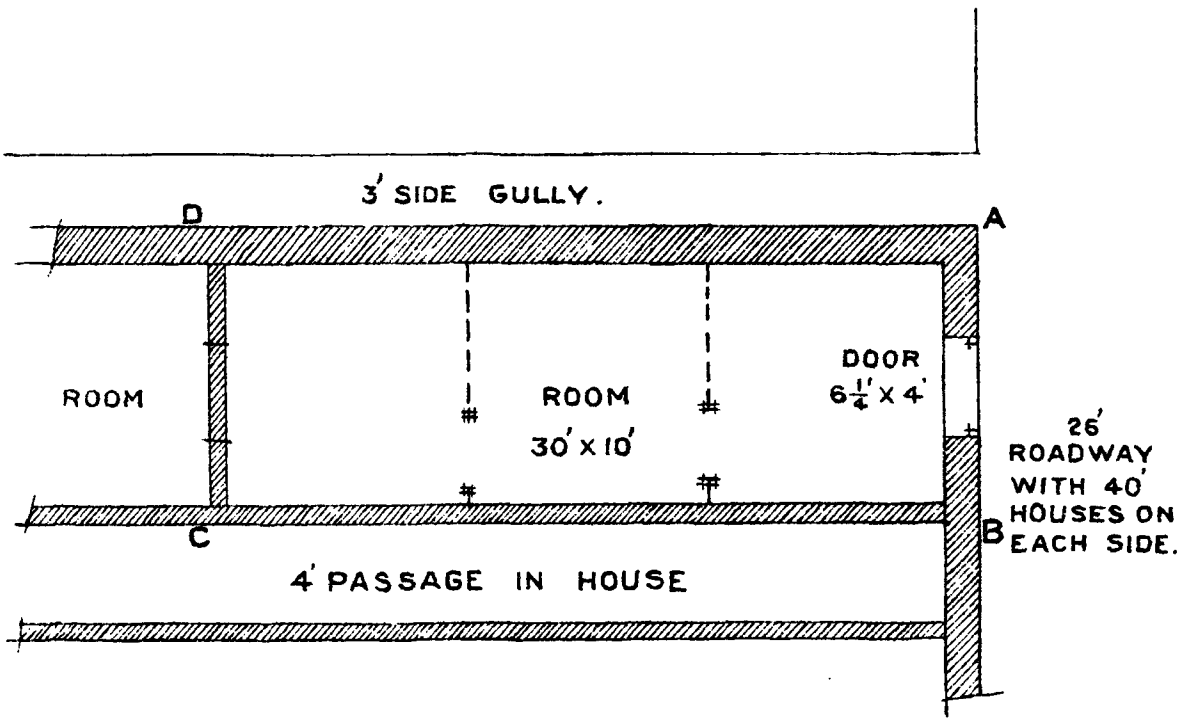
CALCUTTA.



TRUST.

DIAGRAM Nº XIV

SHEWING A CASE OF INADEQUATE LIGHTING
OF A ROOM UNDER MUNICIPAL BYLAWS (VIDE S 39/)



THE DOTTED CHAIN LINES INDICATE PARTITIONS BY WHICH ROOMS ARE COMMONLY DIVIDED INTO SEPARATE TENEMENTS.

APPENDIX B.

The Bombay City Improvement Trust 63½° Air Plane and Light Plane Rules.

1. The regulation (commonly known as "the 63½° rule") which is now enforced in the Bombay City Improvement Trust Estates with a view to securing ample exterior open space around all buildings is as follows :—

"*Every person who shall erect a building on a Trust plot shall provide it with adequate means of access for external air on its rear side and shall provide every room intended for human habitation in it with adequate means of access for external light to the satisfaction of the Plans* Committee who will ordinarily be guided by the following rules :—*

Definitions.—1. *The plane lying between the ground behind a building and the 2 straight lines drawn downwards and outwards from the extremities of the line of intersection of the outer surface of any rear wall of the building with the roof perpendicular to that line and at an angle of 63½° to the horizon is for the purposes of these rules described as a "rear air plane"* (vide Diagram No. I, Appendix "A").

(i) "Rear air plane."

[*Note.*—The 63½° angle has a tangent of 2 : 1; so the air plane always reaches the ground at a distance from the exterior wall equal to half the height of the wall above the level of that ground.]

Explanation.—Ordinarily every wall on the side of a building opposite to the side which abuts on a street or, in case the building abuts on more streets than one, the side opposite to the side which has the longest frontage on a street, is taken to be a rear wall for the purposes of these rules. In cases in which the building abuts on no street, and in other cases in which for any reason there is room for doubt as to which should be treated as the rear walls of a building for the purposes of these rules, the Plans Committee will decide the point, having regard to the probable lay-out of roads and houses in the vicinity in the future and to the desirability of making each owner contribute his fair share to a common rear open space between rows of buildings.

2. *The plane lying between the line of intersection of the floor of any room in a building with the outer surface of an exterior wall of the building and the 2 straight lines drawn upwards and outwards from the extremities of that line perpendicular thereto and at an angle of 63½° to the horizon is for the purposes of these rules described as a "light plane"* (vide Diagram No. II, Appendix "A").

(ii) "Light plane."

(iii) "Permanently open air space."

3. *An air space is deemed to be permanently open if—*

(*i*) *it is encroached upon by no structure of any kind,*

and

(*ii*) *its freedom from such encroachment in future is assured either by law or by Municipal by-laws or by the fact that the ground below it is a street or is appropriated as a permanent open space or otherwise.*†

Standards.

(i) Rear air space.

4. *A building is deemed adequately provided on its rearside with means of access for external air, if the whole space vertically above all its rear air planes is a permanently open air space.*

(ii) Lighting of room for human habitation.

5. *A room is deemed adequately provided with access for external light for the purpose of human habitation, if the whole space vertically above at least one of its light planes is a permanently open air space.*

2. All buildings on Trust Estates abut on streets ; and adequate access of light and air to the *front* rooms is incidentally secured by section 349B of the Bombay City Municipal Act, which limits the height of buildings according to the breadth of the streets on to which they abut. *The rules set out above are directed towards securing ample exterior open space* in rear *of all buildings, whether intended for human habitation or not, and ample interior and side open spaces for the lighting and ventilation of rooms used for human habitation that are not lighted and ventilated from the front or rear of a house ; they practically limit the portion of a building site on which*

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* The Plans Committee is a commitee to which has been delegated the Trust's power to approve or disapprove plans of houses to be built on the Trust's Estates.

† *Vide* suggestion in para. 52.

the building may be built, so that the plinth can never be co-extensive with the site: and incidentally they also limit the height of the rear part of every building in proportion to the open space around it, on the principles—

(1) *that the higher and the more extensive a building is, the greater must the open space around it be*

and

(2) *that such exterior open space is just as much a* sine quâ non *for a house as the plinth, walls or roof.*

There is no difficulty about the application of this regulation in estates which are regularly laid out. The simplest case is illustrated in Diagram No. 3—buildings on 4 regular plots A, B, C, D, situated with others between a 50′ road and an 80′ road parallel to it.

The Air Plane Rule.

3. To consider first the air plane rule :—

This rule is directed towards securing ample open space for perflation of air between and behind rows of buildings, whether these buildings are used for human habitation or not. Incidentally it secures ample means of access for light to all rear rooms and limits the height of buildings in proportion to this open space. It is only recently that this rule has been adopted in its entirety. In the earlier days of the Trust the importance of having *some* absolutely open space at the rear of every building, so that there might be nothing to obstruct the perflation of air currents between rows of back to back buildings was not fully recognised, and consequently, although a rear open space was prescribed, privies, washing places and the like were made exceptions to the general rule that no building could be erected on it. This exception was based on a similar exception which appears in the by-laws of some English towns. In England, however, the exception is in practice confined to ground floor buildings; but the Trust used to permit huge blocks of privies and washing places, sometimes 6 storeys high, to be erected on the rear "open" space. These seriously interfere with the perflation of air and will have to be set back when they are rebuilt. *Now the Trust not only enforce the* $63\frac{1}{2}°$ *rear air plane rule, but, in order to ensure a free passage of air through a space at least* 20′ *broad at the rear of two rows of buildings, they further require that a minimum rear open space* 10′ *wide be kept along each side of a common rear boundary line.* But for this requisition the development shown in Diagram No. 4 would be possible. A and C have arranged for the rear open space required between their plots to be entirely in C's plot while B and D have kept it entirely in B's, and there can obviously be no perflation of air under such arrangements.

Let us now consider the effect of the air plane rule supplemented by the 10′ minimum rule on buildings in the plots shown in Diagram No. 3.

Under Bombay City Municipal Act, section 349B,* there can be a continuous line of buildings 50′ high on the 50′ road and a continuous line of buildings 70′ high on the 80′ road. *If A and B are to be entirely independent of one another, there must under the* $63\frac{1}{2}°$ *rear air plane rule be an open space of* 25′ *depth behind A's building and one of* 35′ *depth behind B's* (*vide* Diagram No. 5); *but if they combine to share the same open space by covenanting with one another for its permanent retention as such, this space of* $(25 \times 35) = 60'$ *between them can be reduced to* 35′ (*vide* Diagram No. 6), *and will not necessarily be half in one plot and half in the other, but may be at any position between the two points* 25′ *on either side of the common rear boundary.* Thus A can build a 50′ high building up to 10′ from the common boundary, if B keeps 15′ rear open space in his compound: but B can then build 70′ high only up to 25′ from the common boundary (*vide* Diagram No. 7); from that point up to the edge of the 25′ rear open space his building must be cut down to 50′. Similarly B can build a 70′ high building up to 10′ from the common boundary, if A keeps a 25′ rear open space in his compound (*vide* Diagram No. 8); and A can then build 70′ high from the rear open space up to 20′ from the front, when his building would meet what we may call the 45° front air plane and he would, under Bombay City Municipal Act, section 349B† and its proviso have to reduce the height, limiting the front wall to 50′.

The Light Plane Rule.

4. To consider next the light plane rule :—

This rule applies, not like the air plane rule, to the whole side of a house but to particular rooms; in practice, however, it is unnecessary to consider it in reference to more than the lowest floor used for human habitation, because it is obviously satisfied for all the upper floors, if it is satisfied for the lowest.

The object of this rule is to secure ample means of access of light to rooms intended for human habitation. Incidentally it provides for access of air also; and

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* *Vide* Appendix D. † *Vide* Appendix D.

it is for the sake of better provision of both light and air that the light-plane is taken as extending to the whole breadth of the exterior wall of a room and not only to the breadth of its windows and as rising from floor level and not only from window sill level.

To explain the light-plane rule in its application to rear, front, interior and side rooms in a house :—

(*a*) REAR ROOMS.

Rear rooms can be dismissed at once ; for the application of the 63½° air-plane rule to any house incidentally secures compliance with the light-plane rule of the house behind it. For instance, even when A and B of Diagram No. 3 are in the closest permissible proximity to one another, the air plane of each is *below* and parallel to the light plane of the lowest room in the other, vertically separated from it by the height of the plinth (*vide* Diagram No. 9) ; and obviously, if the space above the air plane is open, so is the space above the light plane. The air plane rule therefore secures even more light for rear rooms than the light plane rule, and the excess is the greater the further apart the houses are set, and the higher the rooms concerned.

(*b*) FRONT ROOMS.

Similarly with *front rooms ;* only there, as the air plane is generally a 45° plane and never at a greater inclination to the horizon than 63½° (*vide* Diagram No. 10), the air plane is farther below the light plane than in the rear of the house and the extra light provided is therefore considerably more than in the rear.

(*c*) INTERIOR ROOMS.

Interior rooms, i.e., *rooms abutting on an open " chauk " within the building, are entirely dependent for their light on the light plane rule ; and consequently the chauks of a building A* 70′ *high must* (*vide* Diagram No. 11) *be at least* 34′ *in width and those of a building B* 50′ *high* 24′ *in width, if the lowest rooms are on a* 2′ *plinth and are intended for human habitation.* [Outside Trust Estates chauks 70′ high are commonly found with a breadth of only 6′ (*vide* Diagram No. 12) ; and even then the air space is encroached upon by eaves or other projections.] If B's ground floor rooms are godowns 16′ high on a 2′ plinth (*vide* Diagram No. 13), the lowest light planes will be those of the first floor rooms, and the chauk must be at least 26′ broad ; and if A has similar godowns on his ground floor (*vide* Diagram No. 14), the breadth of his chauk can be reduced to 16′ ; but the 6′ × 6′ chauk so common in residential buildings outside Trust Estates would never be allowed in Trust Estates, except possibly in a ground floor building.

(*d*) SIDE ROOMS.

Side rooms, i.e., rooms lighted not from the front or rear of the house or from interior chauks but from the side of the house, must under section 348 (1) (*e*)* of the Bombay City Municipal Act, abut on an open space ; but that space is not required by the Act to be more than 2′ broad, and such 2′ side spaces are commonly found outsideTrust Estates. *The revised Municipal bye-laws of* 1910 *raise the* 2′ *to* 6′ *for* 70′ *buildings ; but on Trust Estates the* 63½° *light plane rule requires the side open space between buildings* 70′ *high with* 2′ *plinth to be at least* 34′ *broad* (*vide* Diagram No. 16). If A in Diagram 3 wants a side open space, but C doesn't, the whole 34′ must be provided by A ; but ordinarily Trust Estates are laid out so that the building areas are of the T-shape (*vide* Diagram No. 15) and the side open spaces are shared by contiguous plots. In the case shown in Diagram No. 13 the buildings on plots A and C may be 50′ high throughout ; but those on plots B and D though they may be 70′ in front, must (*vide* Diagram No. 5) be reduced to 50′ in the rear extensions, because there are on the ground floor rooms (Nos. 2, 3, 5 and 6) for human habitation dependent on the side open spaces for their light. From the cross section (Diagram No. 16) it will be seen that, had only the 63½° rear air plane rule been enforced, the reduction from 70′ to 50′ would have been required only over the rearmost 10 of buildings B and D ; but then the ground floor rooms 2, 3, 5 and 6 would have been deemed unfit for human habitation as not satisfying the 63½° light plane rule. To make them fit for human habitation the light plane rule practically necessitates the reduction of the whole 25′ of the extension to 50′ height. This is made clear by Diagram No. 17, which shows how any building above 50′ height would encroach on the light plane of the ground floor side rooms.

If no building lines have been laid down by the Trust, and A and C combine to share a common side space in a T-shape building plan, the common space must be 25′ broad between 50′ buildings and may come anywhere between the two points 25′ on either side of the common boundary. *In general, if the lowest rooms on both*

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* *Vide* Appendix D.

sides of a common boundary are to be used for human habitation, the common side space must have a breadth at least equal to half the height of the higher building above the plinth. For instance, if C of Diagram No. 13 elects to make his rear buildings only 42′ high, while A makes his 52′ high, the common space must (*vide* Diagram No. 18) be 25′ broad. [If it were only 20′ broad (*vide* Diagram No. 19), the light plane rule of ground floor rooms would be satisfied in A's house, but not in C's.] The space being 25′ broad, C will be at liberty to raise his building to 52′ at any time (*vide* Diagram No. 18), but if the space is 20′ broad, neither building can be raised above 42′ height unless the ground floor rooms in the other building are either living rooms not dependent on this open space for their light or godowns (*vide* Diagram No. 20).

If in both houses the ground floor rooms of the two rear wings are not for human habitation (*e.g.*, godowns), the common side space can be so much narrower ; its minimum breadth will be equal to half the height of the highest side wall above the floor level of the lowest room used for human habitation. Thus if C's building runs to 26′ above the godown and A's to 36′ above his (the godowns both reaching to 18′ above ground) (*vide* Diagram No. 21), the side space can be reduced to 17′ breadth and C can always add another 10′ storey. In such cases there may be no objection to the side open space being built over up to the height of the godowns ; but the rooms in this extra building must be godowns or privies or other rooms not used for human habitation.

Complex cases and exceptions.

5. This exposition of the application of the air plane and light plane rules to the simplest cases will, it is hoped, have given the reader a clear idea of the principles of these rules.

In applying the rules to more complex cases it should be borne in mind that the air plane rule is directed towards securing ample rear open space for perflation of air between rows of houses *and that it incidentally secures ample means of access for light to rear rooms ; while the light plane rule is directed towards securing ample means of access for light to rooms intended for human habitation and dependent for light and air on* interior or side *open spaces.*

It should also be remembered that while a rate-payer can rightly claim a share in the amenities resulting from the appropriation of land for public streets or open spaces, including in such amenities means of access for light and air to the adjoining houses, he has no such claim upon private land ; so, if he cannot persuade his neighbour to allow him a share in the open space above that neighbour's land, he must just provide the exterior open space required for his own building upon his own land.

There is some difficulty in applying the rules to irregularly developed estates, especially to those in which buildings already exist, because in the great majority of cases owners have erected their houses much too near the boundaries of the house sites in utter disregard of their own and other houses' need of adequate means of access for light and air.

This difficulty can be overcome by allowing some elasticity in the application of these rules to complicated cases, provided there is no *substantial* departure from the principles underlying them. Trifling deviations from the standard set by the rules are allowable even in regularly developed estates where the deficiencies which they involve in means of access of light and air from one direction are more than counterbalanced by extra means of access from some other direction beyond the minimum required.

For instance the projection of open balustraded parapet walls not more than 4′ high or of window shades, vent shafts and the like above the light plane or air plane may be ignored ; and the encroachment of a building to a slight extent over one corner of the air plane may be condoned, if there is more than the required open space close by, so that a give and take line (*vide* Diagram No. 22) is substituted for the line in which the air plane meets the ground.

The most substantial permanent structure which the Trust, following the Municipality's practice, make an exception to the rule that there must be no structure above the air plane and the light plane is the ordinary verandah, provided it projects not more than 4′ from an exterior wall. The outer wall of a roofed verandah is however treated as the exterior wall of the house, so that the light plane is drawn from the outer not from the inner edge of the verandah floor. In an unroofed verandah the light plane is drawn from the inner edge, *i.e.*, according to the ordinary rule, from the line of intersection of the room floor with the exterior wall of the house. In streets with a width of 75′ or more, verandahs may be more than 4′ broad without infringing the air plane and light plane rules ; for there is a space of more than 4′ between the points at which the air planes reach the ground and the opposite house. In Diagram No. 32 are shown various instances of verandahs allowed and verandahs disallowed under Trust rules.

6. *Temporary deviations of a more substantial character are tolerated in cases in which hardship would be entailed by a strict enforcement of the rules in the neighbourhood of existing buildings. The commonest of such cases are those in which the rear part of an old building encroaches on the space above a light plane, but that old building itself infringes those rules in being too close to the edge of the plot in which it stands. In such cases the old building is for the purposes of these rules assumed to be already set back to its ultimate position under the following rule which the Municipality are shortly to be moved to adopt for the purpose of creating adequate rear open spaces between rows of back to back buildings :—*

" Buildings on either side of a common rear boundary shall, on reconstruction, be set back so, that the open space between the lower building and the common boundary shall be one-fourth as broad as the lower building is high, and the open space between the two buildings shall be half as broad as the higher building is high."

7. To take a concrete case,—suppose the Trust want to put a building A 66′ high on a plot 45′ deep, behind which is a building B 44′ high only 5′ from the common boundary ; we may assume that, on re-building, the 44′ house will be set back 6′ so as to be ($\frac{44}{4}$ =) 11′ from the common boundary ; and the Trust building may therefore be set back (33 - 11 =) 22′ (*vide* Diagram No. 23) from the common boundary instead of 28′, which would be necessary, if the strict 63½° rule were at once enforced, even if A could take advantage of B's existing 5′ margin.

Until the other building is set back, its lowest rooms will get light short of the 63½° standard ; but the Trust's lowest rooms will be all right. After the other building is set back, both buildings will satisfy the 63½° rule.

If the Trust building is to be 44′ high and there is a building 66′ high, 5′ from the common boundary (*vide* Diagram No. 24), it may be assumed that that building will ultimately be set back 17′ to a line (33′ – $\frac{44}{4}$ =) 22′ from the common boundary, so that the Trust can build up to 11′ from the common boundary. There will then be only 16′ between the buildings, until the other is set back. This 16′ space is not far short of the 22′ required to give the lowest rooms in the 66′ building its 63½° of light ; but the top 32′ of that building will be above the light plane of the ground floor rooms of the other, and the rooms will consequently get far less light than they should, unless the deficit is made good by transverse light coming from open air spaces on the two sides of the 56′ building. This 16′ space, however, is far more than the 9′ required by the Municipal bye-laws in the case cited or the 10′ that would be required by them if both buildings were being newly built. It is almost incredible, but it is a fact, that if the 66′ building were right on the owner's boundary the Municipal bye-laws would still permit the owner of the 44′ building to erect it at a distance of 4′ from the 66′ building. Under the rule now proposed the 44′ building would in such a case be at any rate set back 11′ from the 66′ building and the 66′ building would ultimately be set back 22′ ; so as to leave 33′ between the buildings.

8. Sometimes there is between the rear of a Trust plot and the front of a private holding not a mere line as common boundary but a public lane. The same principles will apply there ; but measurements will be taken from the centre of the lane. Take for instance the plots on either side of Paper Mill Lane, Girgaum. In the Trust plots to the east of the lane a rear open space of 12′ has been prescribed at the point shown in diagram 25, where the lane is 14′ broad. The houses on the Trust Estate will therefore be limited to a 52′ height in rear (they are actually being built only 45′ high, though they do not encroach on the 12′ rear open space as would be permissible to the extent of (14 + 12 – 22½ =) 3½′ if only the rear air plane rule were applied. The houses built up to the edge of the lane in the private Estates on the west are limited under section 349B of the Bombay City Municipality Act to a maximum height of 21′ in front (1½ times the breadth of the lane) ; but there seems to be no good reason why the Municipality should not adopt the 45° front air plane rule here in which case the private owner could arrange with the Trust to get the advantage of their 12′ strip being permanently open, so as to permit of his buildings being raised to a height of 26′ without a set back (*vide* Diagram No. 26). The Trust would however probably stipulate that when rebuilding he should set back 8′ from the lane so as to provide a 34′ space between the buildings and permit of the buildings on the Trust plot being raised by 2 storeys to 68′ ; the other building could then be raised to 34.′

9. The two cases cited in paragraph 7 (Diagrams Nos. 23 and 24) are good cases to take as illustrations in the light of which to examine the ethics of the Trust's method of dealing with the situation. In the first case (Diagram No. 18) it may be assumed that the proposed 66′ building (A) is to be erected along a new Trust road 80′ broad on a shallow plot left over out of a property acquired mainly for absorption in the road. The 66′ height is required in order that the new building may harmonise with other fine new buildings along the road ; but if the 63½° air plane rule is strictly enforced and the owner of the 44′ building (B) will not allow any easement

over the 5′ open space in the rear of his building, a rear open space of 33′ will have to be provided in the Trust plot, if A's building is to be 66′ high throughout (*vide* Diagram No. 27). This may render the remainder too shallow for a 66′ building (*e.g.*, if the plot is only 45′ deep, as many Trust plots are along Sandhurst Road and Princess Street) and the value of the Trust plot becomes immensely reduced compared with what it would be if only the Municipal bye-laws were applied ; for these bye-laws would permit of the 33′ space being cut down to 6′. It would surely not be right for the Trust to submit to such depreciation ; for they are bound to make the most they can of their funds and property. And who would gain if they did ?—the owner of the 44′ house in the rear. He would enjoy all the amenities of the 33′ space gratis. Perhaps, before the Trust came along, it was covered with buildings and he had only his 5′ space for access of light and air. This now becomes a 38′ space and B is at liberty to encroach upon it by setting his whole house forward by 1′ and may even take up 3′ of the 5′ margin with privy blocks without infringing Municipal bye-laws. The Trust can indeed hoard him in ; but they would never do so, as their function is to improve the sanitary condition of the localities in which they work. From similar considerations they would abstain from building up to 6′ from the boundary ; they would adopt a middle course based upon the principle that neighbours should be expected to meet one another half way, in order to get their present condition improved and a further improvement up to the minimum standard ensured in the future. In the first case (Diagram No. 23) the present improvement is the increase of space between the buildings from the (6′+5′=) 11′ required by Municipal regulations to (22′+5′=) 27′ under the compromise at the expense of the Trust, while the future improvement is the addition of a further 6′ out of the neighbour's land making the space between the buildings 33′ broad. The Trust are better off with (45′—22′=) 23′ depth to build on than with the (45′—33′=) 12′ depth, which alone would have been available if the 33′ open space were to be provided in their own plot. The neighbour, on the other hand, is far better off with an open space of 27′ behind his building than he would be if the Trust hoarded him into his 5′ space ; and he will suffer less by having to set back 6′ when his house is rebuilt than if he were then to be required to supply the rear open space according to the 63½° air plane rule entirely in his own land and so set his 44′ house back 22′ instead of 6′, or, if he wanted to build as far as permissible on the old plinth, cut the height down from 44′ to 10′ in the rear.

In the second case (Diagram No. 24) the present improvement is the increase of the space between the buildings from the (4′+5′=) 9′ required by Municipal regulations to (11′+5′=) 16′ under the compromise at the expense of the Trust, while the future improvement is the addition of a further 17′ out of the neighbour's land to make the space between the buildings 33′ broad. The Trust are better off with (45′—11′=) 34′ depth to build on than with the (45′—22′=) 23′ which alone would have been available if the 22′ open space were to be provided in their own plot. The neighbour, on the other hand, is far better off with an open space of 16′ behind his building than he would be if the Trust hoarded him into his 5′ space ; and he will suffer far less by having to set back 17′, when his house is rebuilt, than if he were then to be required to supply the rear open space according to the 63½° air plane rule entirely in his own land and so set his 66′ house back 28′ instead of 17,′ or, if he wanted to build as far as permissible on the old plinth, cut the height down from 66′ to 10′ in the rear.

10. It will be observed, on comparing the two cases that the higher the proposed house is, the greater must be the Trust's immediate sacrifice in the shape of open space, while on the other hand the higher the existing house is, the greater must be the owner's ultimate sacrifice in the shape of set back. This sets high building at a discount, which is as it should be. It is, however, to be observed that in localities like the Fort, in which there is great demand for accommodation, and consequently land is very valuable, it is proposed to substitute a 68° for a 63½° rear air plane, in recognition of the necessity of being content with lower sanitary standards where economic considerations so required. In such localities, therefore, the adoption of the Trust policy will entail less discouragement of high buildings and less loss on alteration of existing buildings than if the 63½° rule were universally adopted. The effect of the 68° rule is shown in Diagrams Nos. 28 and 29, corresponding respectively to Diagrams Nos. 23 and 24.

It will also be observed that the Trust policy involves no negotiations with the owners of existing houses. Experience has shown that such negotiations are generally futile. An owner backed by the existing Municipal bye-laws will rarely come to terms with the Trust, but will take every possible advantage of the Trust's improvement policy to improve his own property at the Trust's expense. The Trust now rely on the Municipality to amend their bye-laws so as to put pressure on private owners to make them combine for their mutual benefit, and it is a great satisfaction to know that a Municipal Committee appointed to revise the Municipal bye-laws have decided to recommend amendments on these lines.

DIAGRAM Nº 3 VIDE PARA: 2

GROUND PLAN OF PLOTS

REFERRED TO IN THE FOLLOWING DIAGRAMS

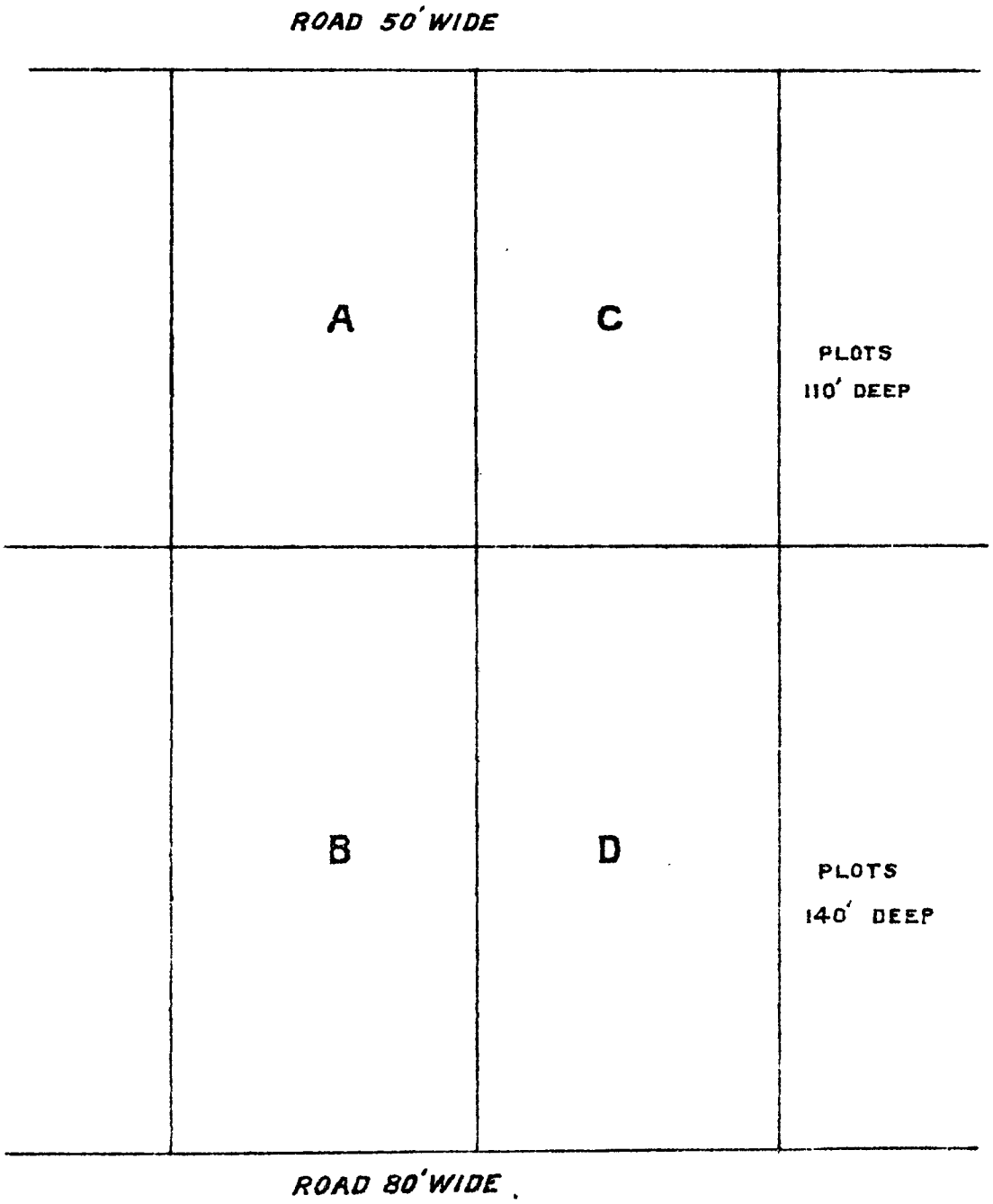
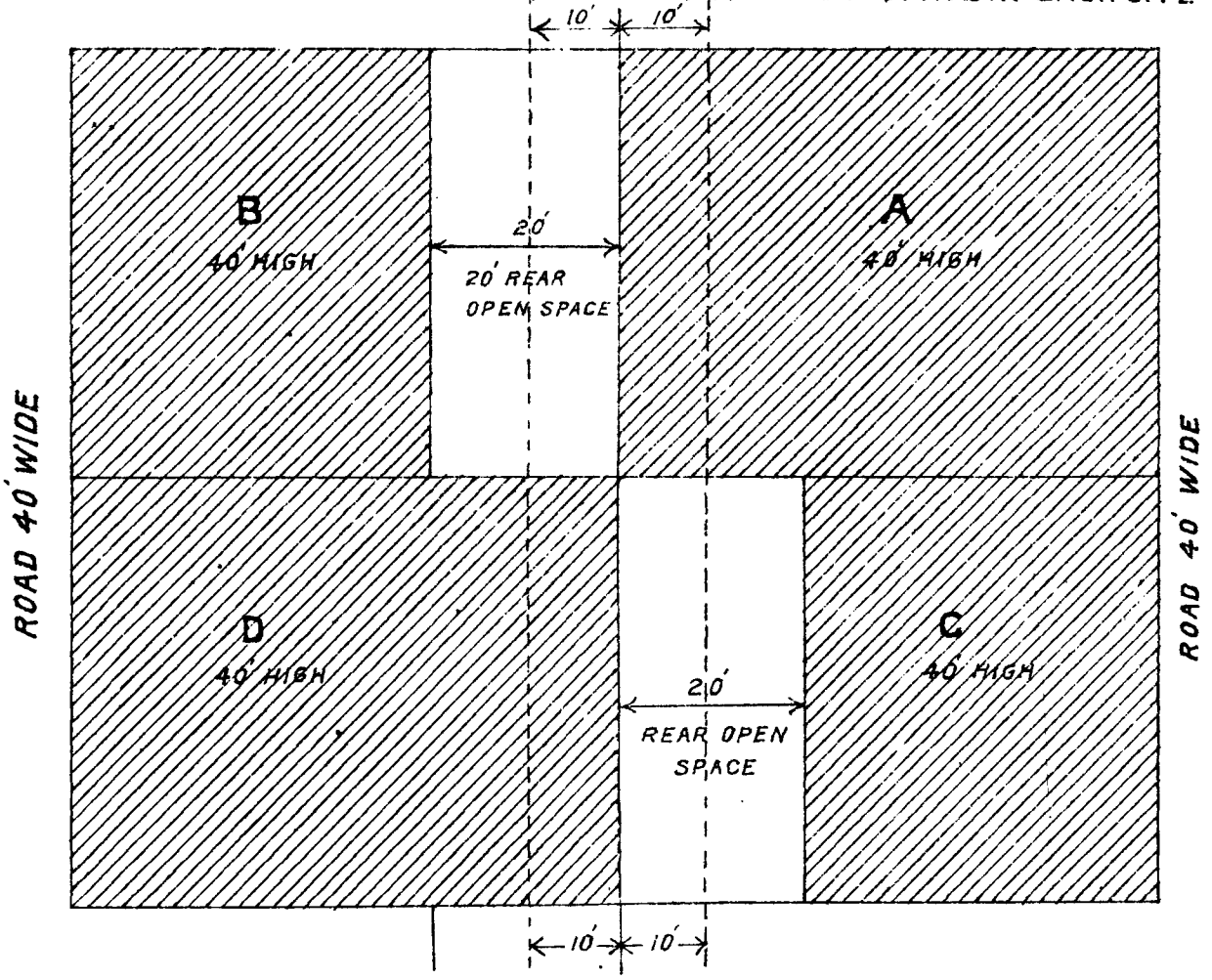


DIAGRAM No. 4 VIDE PARA 3.

SHEWING HOW PERFLATION OF AIR AT THE REAR OF HOUSES MIGHT BE OBSTRUCTED IF THE $63\frac{1}{2}^{0}$ REAR AIR PLANE RULE ALONE APPLIED WITHOUT RESERVATION OF THE MIN.M REAR OPEN SPACE IN EACH SITE



The dotted lines indicate the boundaries of the Min.m rear open space prescribed by the Trust.

DIAGRAM Nº 5 VIDE PARA 3.

SHEWING BUILDINGS ENTIRELY

INDEPENDENT OF ONE ANOTHER.

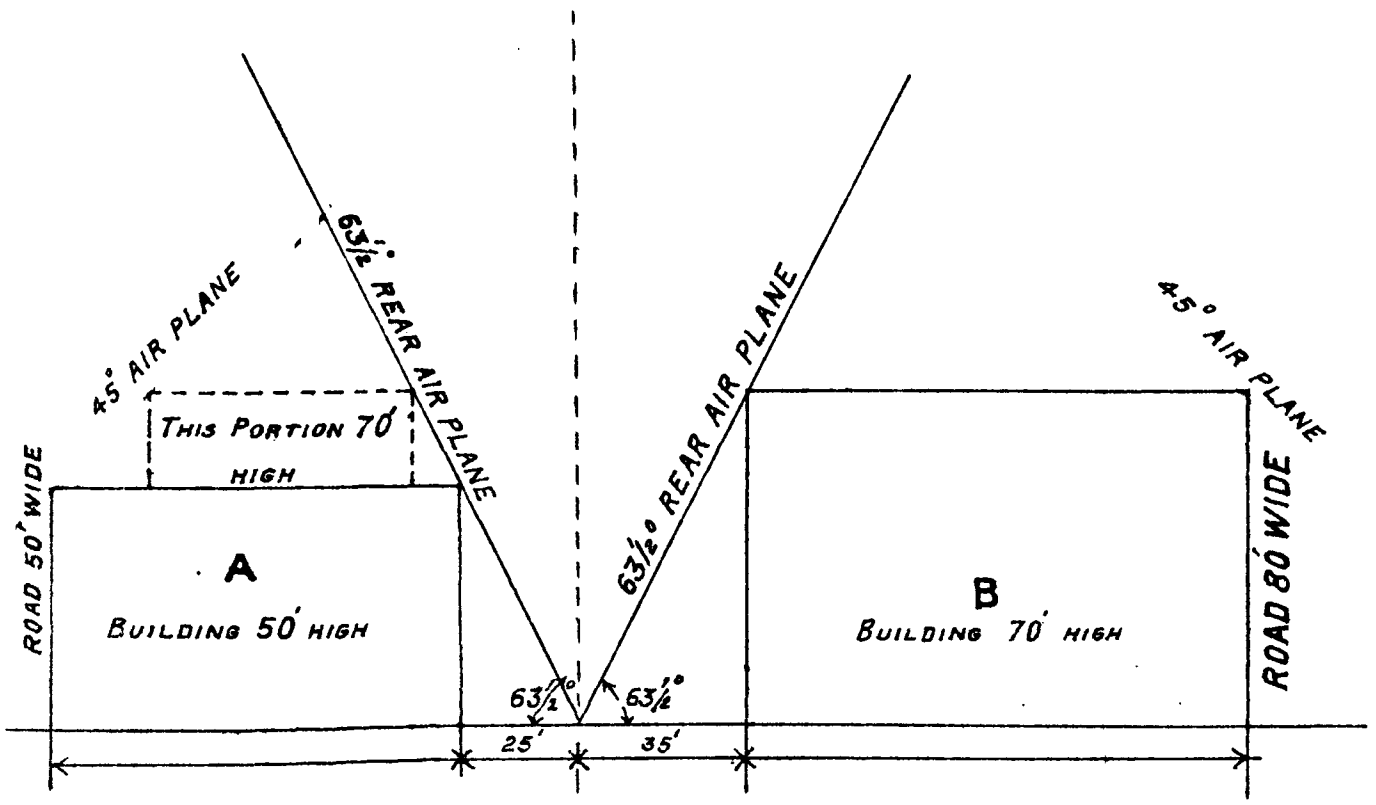


DIAGRAM No. 6 VIDE PARA 3.

SHEWING A COMMON REAR OPEN SPACE SHARED EQUALLY BY BOTH PROPERTIES.

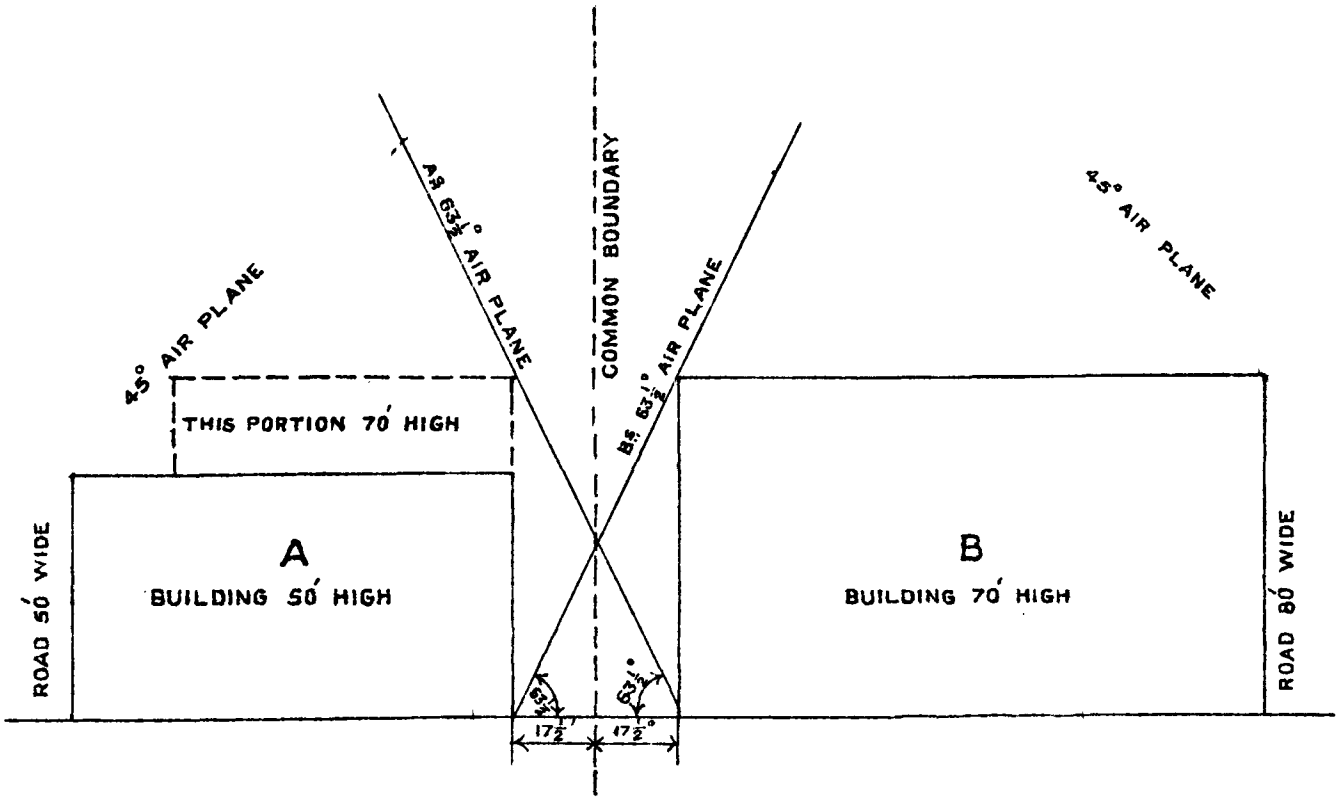


DIAGRAM No. 7 VIDE PARA 3.

SHEWING As MAXm DEPTH FOR A 50' BUILDING WITH A 10' REAR OPEN SPACE IN EACH SITE.

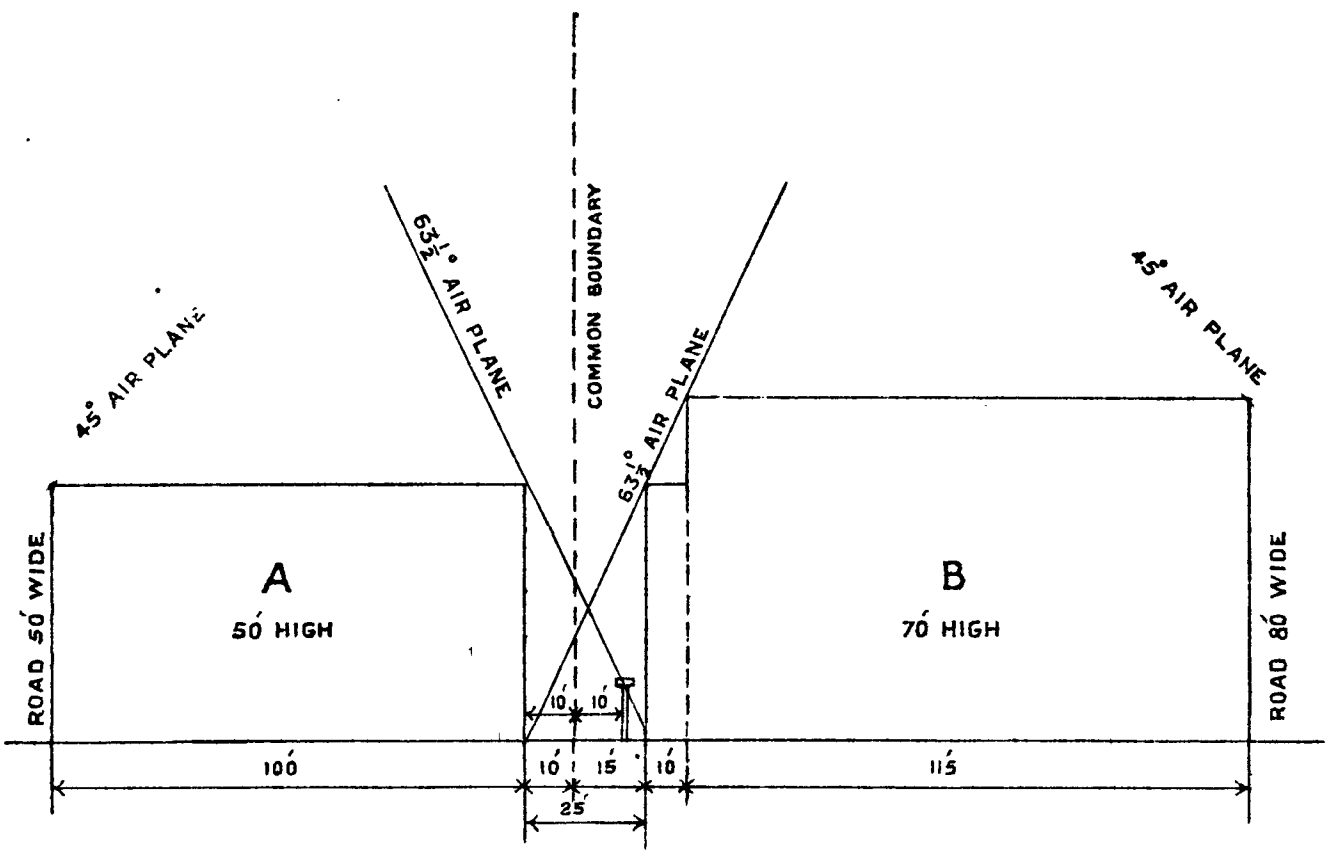


DIAGRAM Nº 8 VIDE PARA 3.

SHEWING B'S MAXM DEPTH FOR A 70' BUILDING WITH A 10 MINM REAR OPEN SPACE IN EACH SITE.

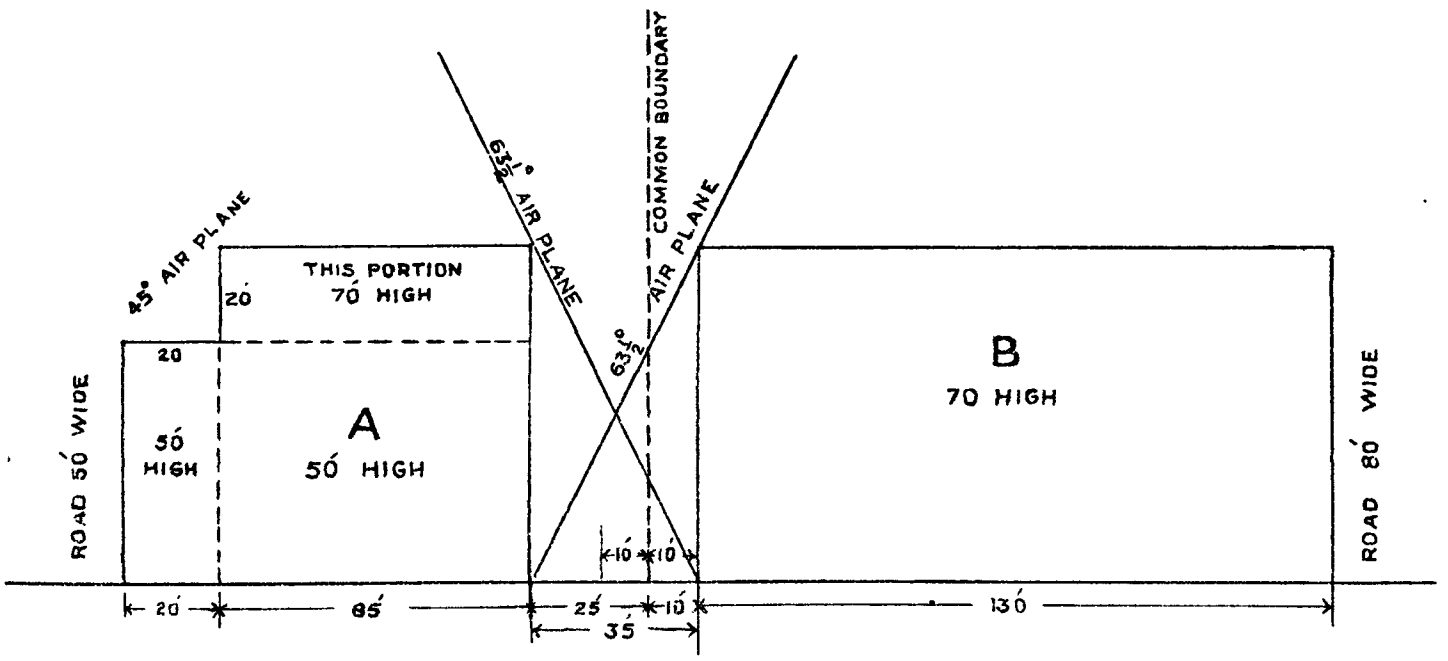


DIAGRAM N° 9 VIDE PARA 4.

SHEWING RELATIVE POGITIONS OF $63\frac{1}{2}°$ AIR PLANES & $63\frac{1}{2}°$ LIGHT PLANES.

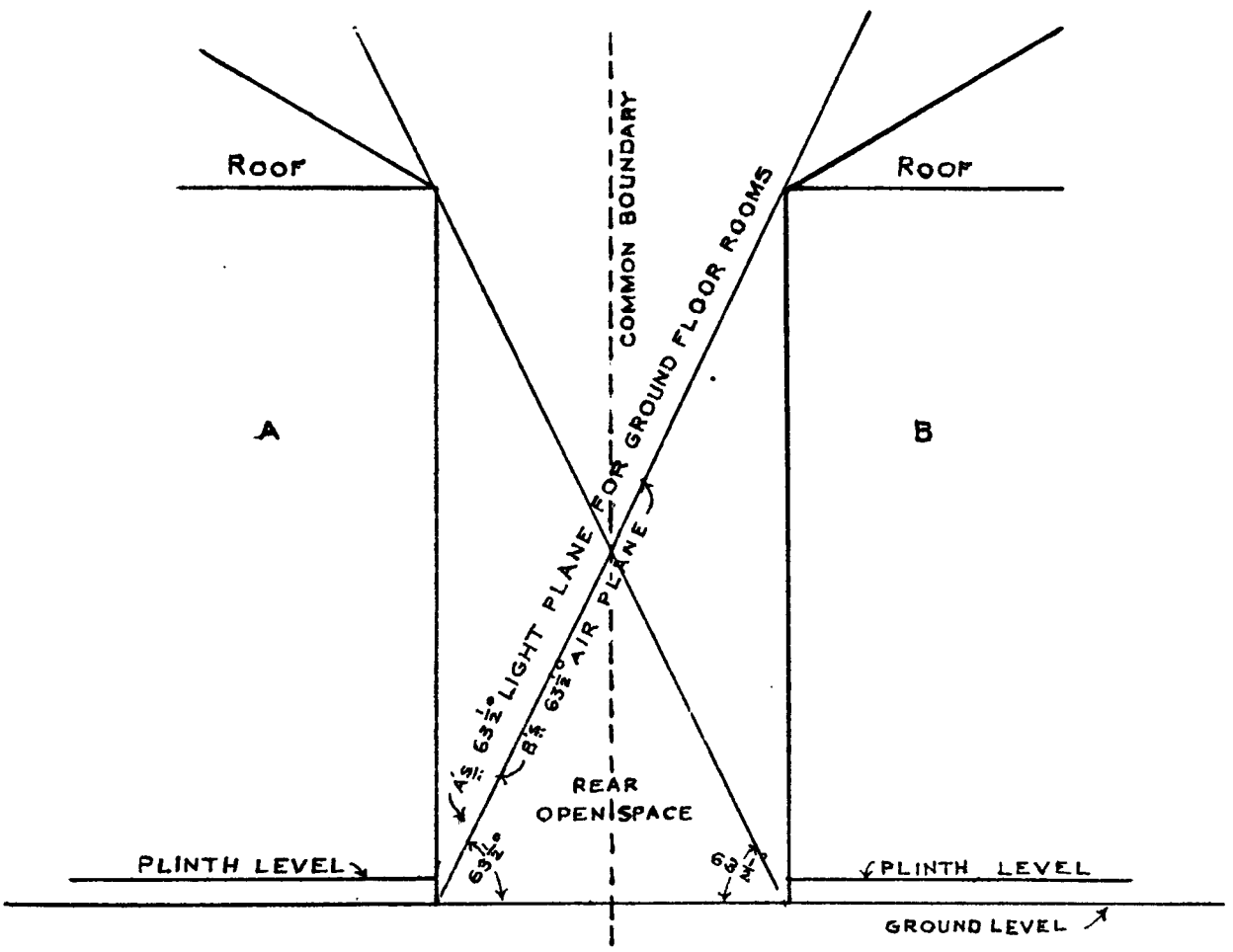


DIAGRAM Nº10 VIDE PARA 4.

SHEWING RELATIVE POSITIONS OF 45° AIR PLANES & 63½° LIGHT PLANES.

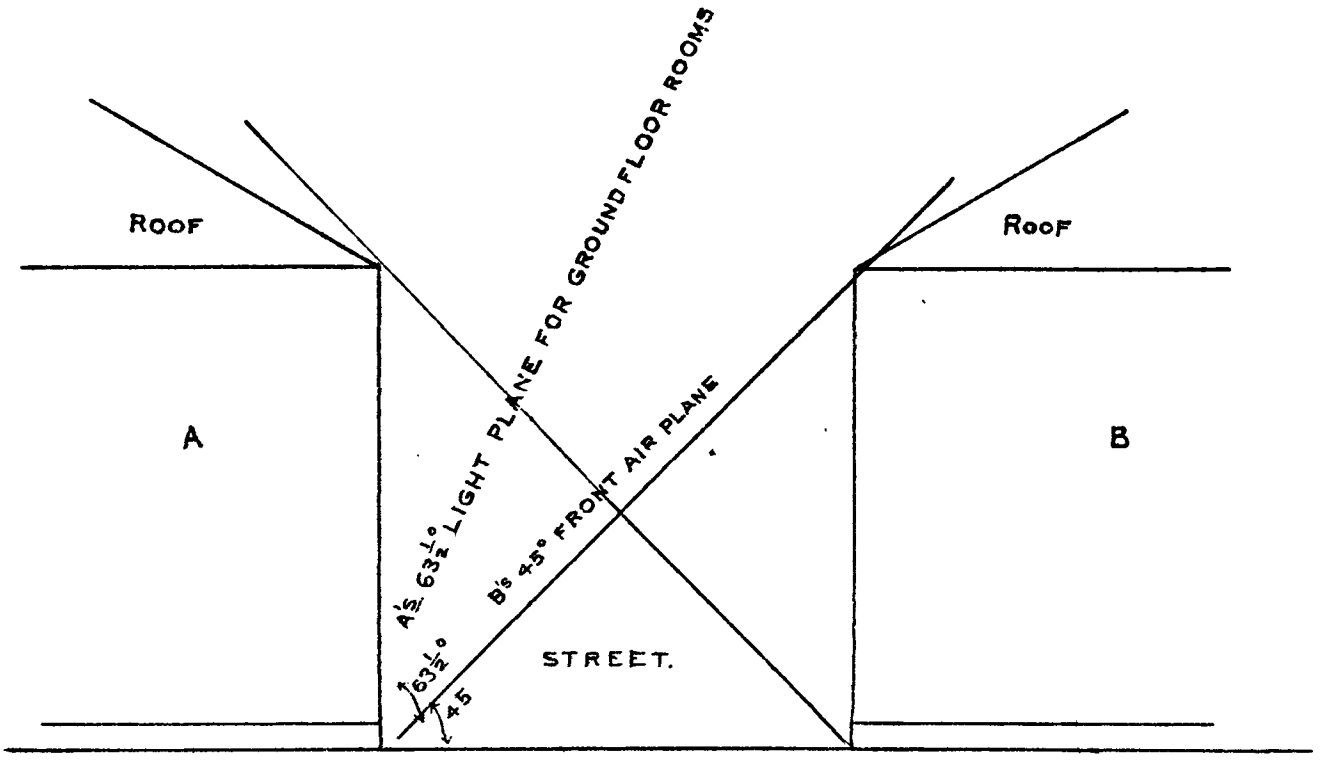
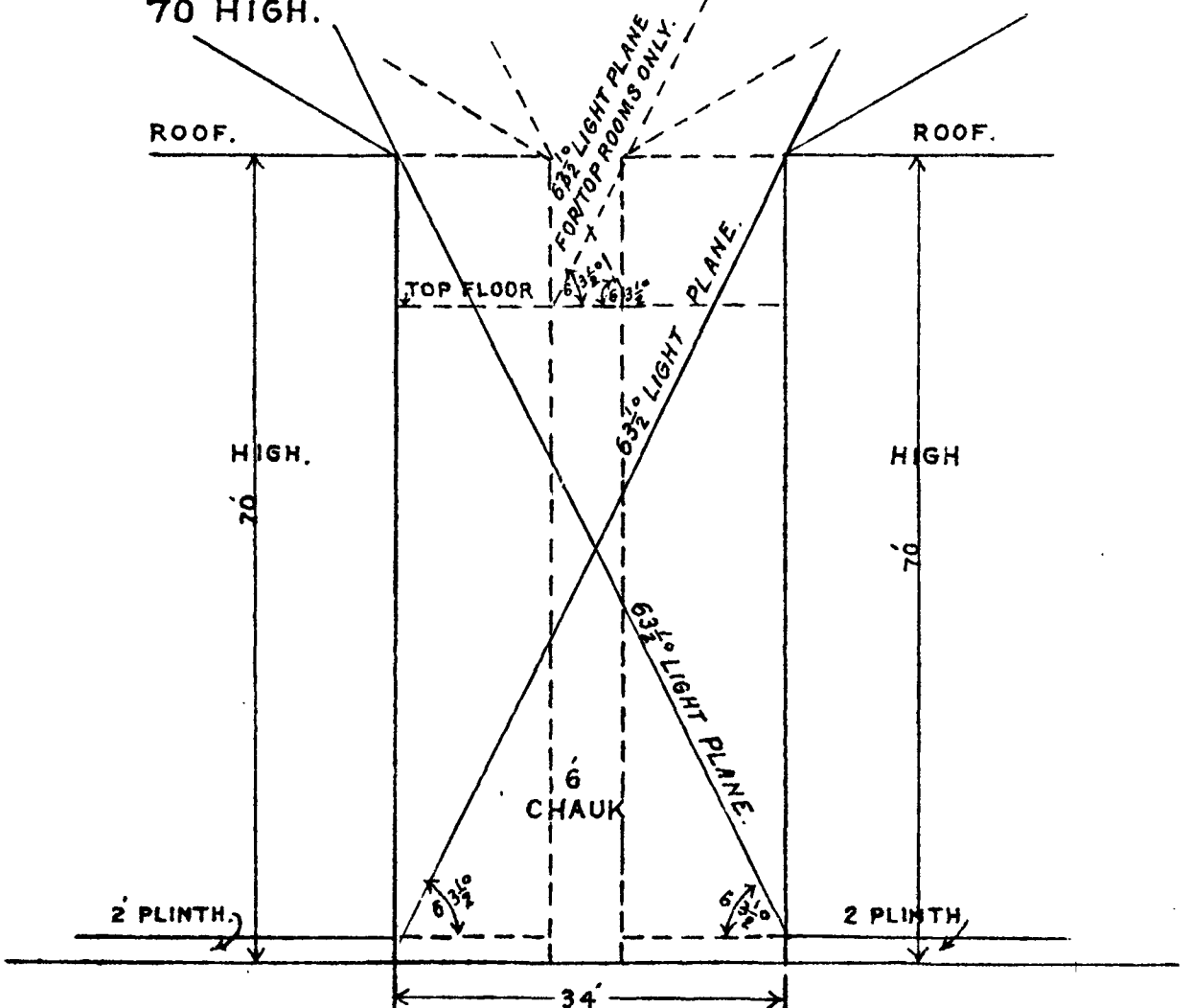


DIAGRAM Nº 11 VIDE PARA 4.

LIGHT PLANE IN INTERIOR CHAUK 70 HIGH.



DOTTED LINES INDICATE THE 6' CHAUK COMMONLY FOUND OUTSIDE TRUST ESTATES IN BOMBAY. ONLY THE TOPMOST ROOMS GET SUFFICIENT LIGHT ACCORDING TO 63½° STANDARD.

DIAGRAM No. 12 VIDE PARA 4.

LIGHT PLANE IN INTERIOR CHAUK 50' HIGH.

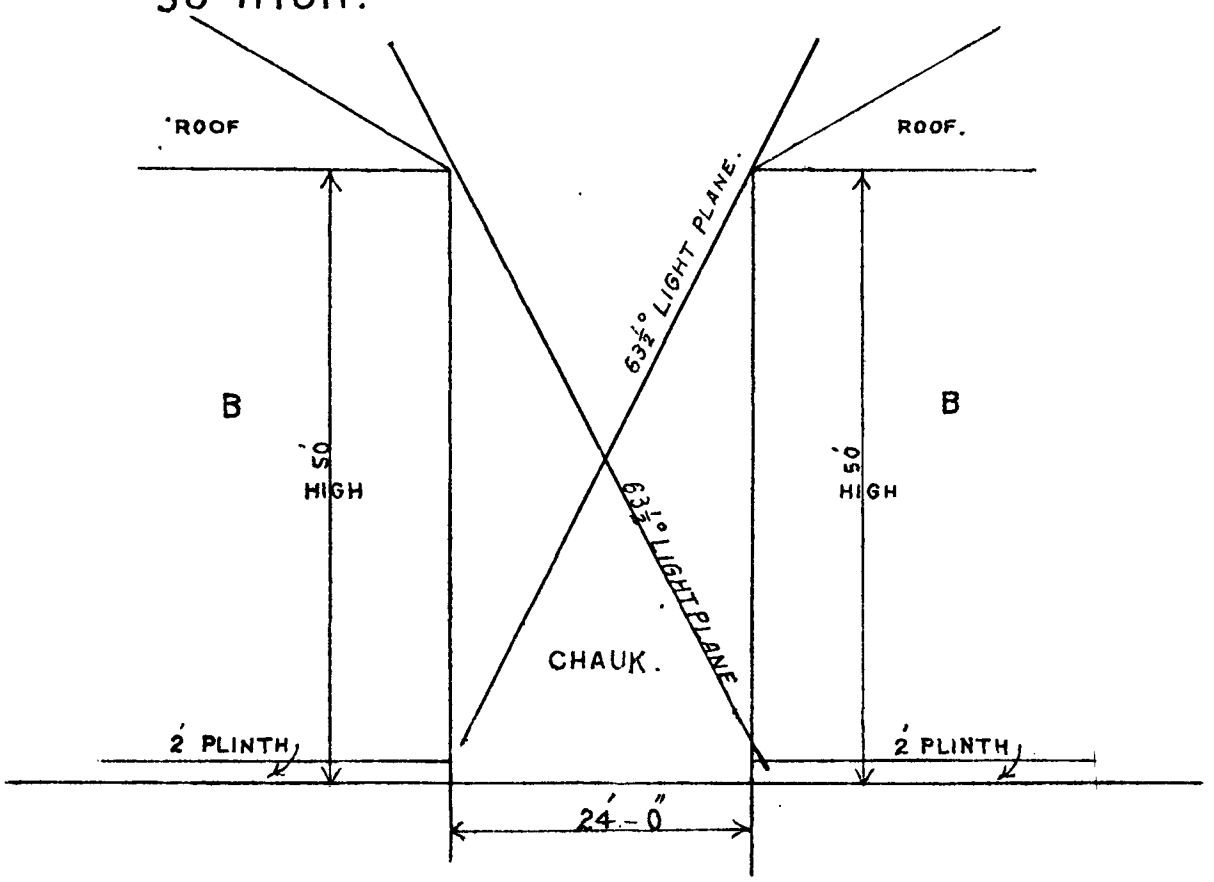


DIAGRAM No. 13 VIDE PARA 4

LIGHT PLANE IN INTERIOR CHAUK 70' HIGH WITH GODOWNS ON GROUND FLOOR.

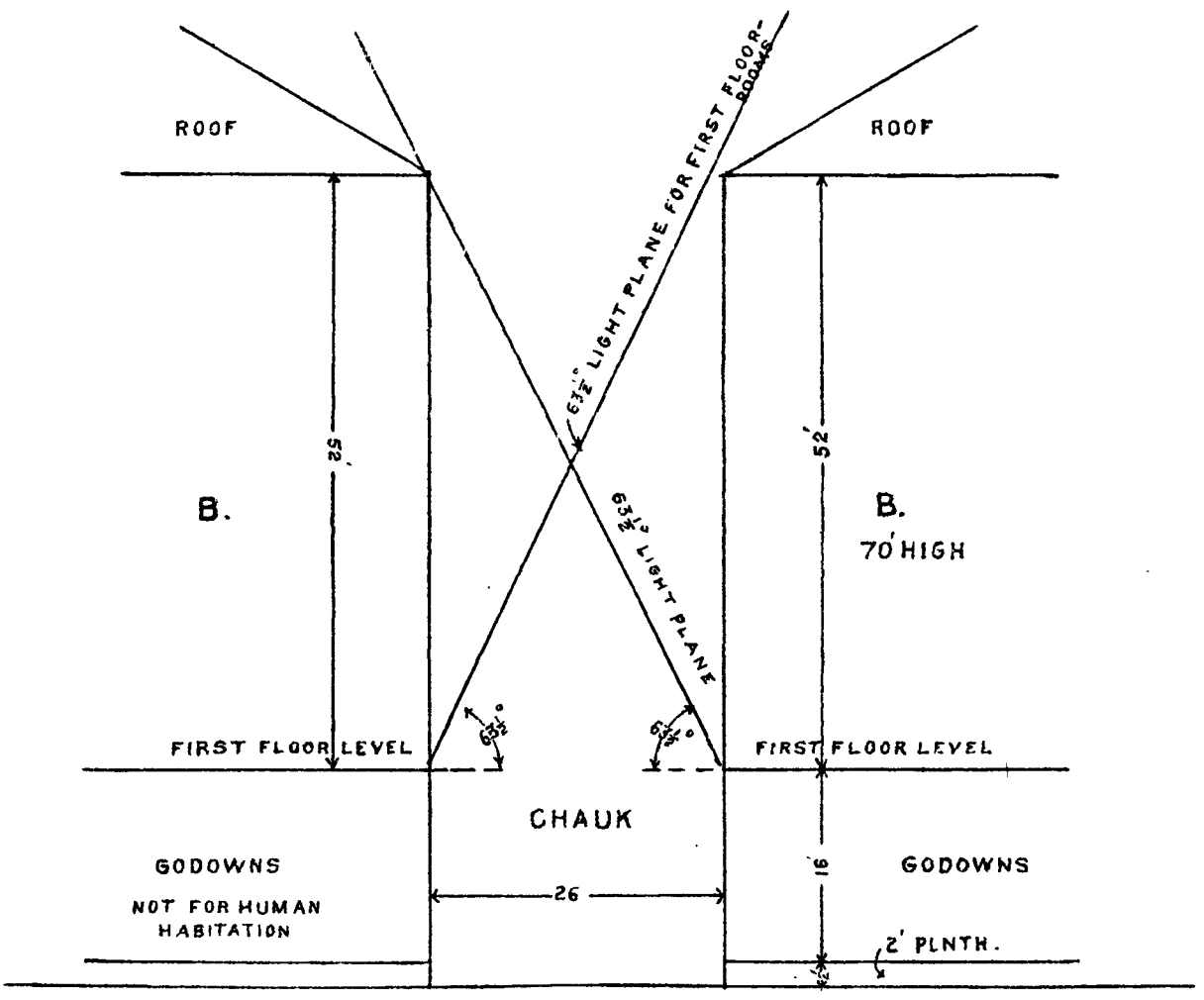


DIAGRAM No. 14 VIDE PARA 4

LIGHT PLANE IN INTERIOR CHAUK 50' HIGH WITH GODOWNS ON GROUND FLOOR.

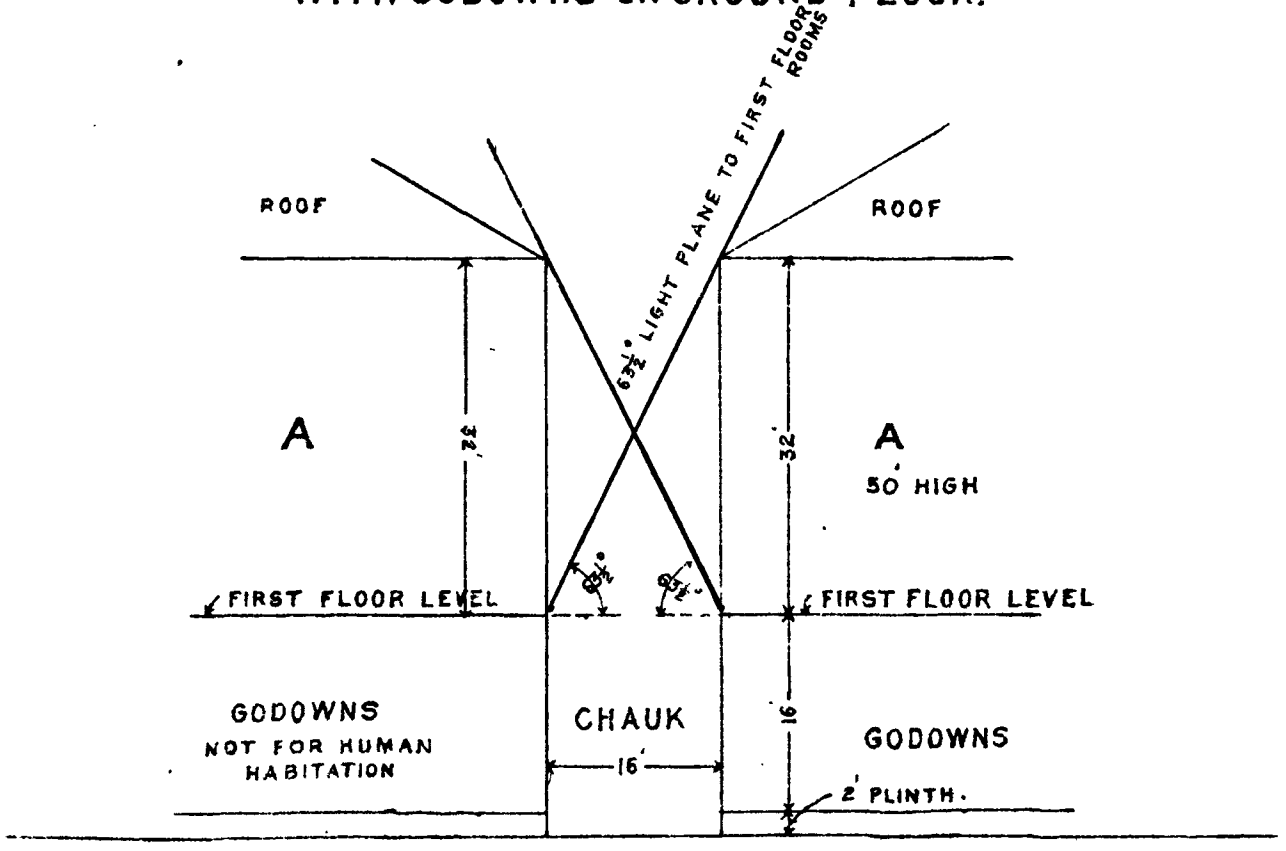


DIAGRAM No 15 VIDE PARA 4.

SHEWING REAR EXTENSION OF 70' BUILDINGS REDUCED TO 50' TO SATISFY 63½° LIGHT PLANE IN SIDE OPEN SPACES.

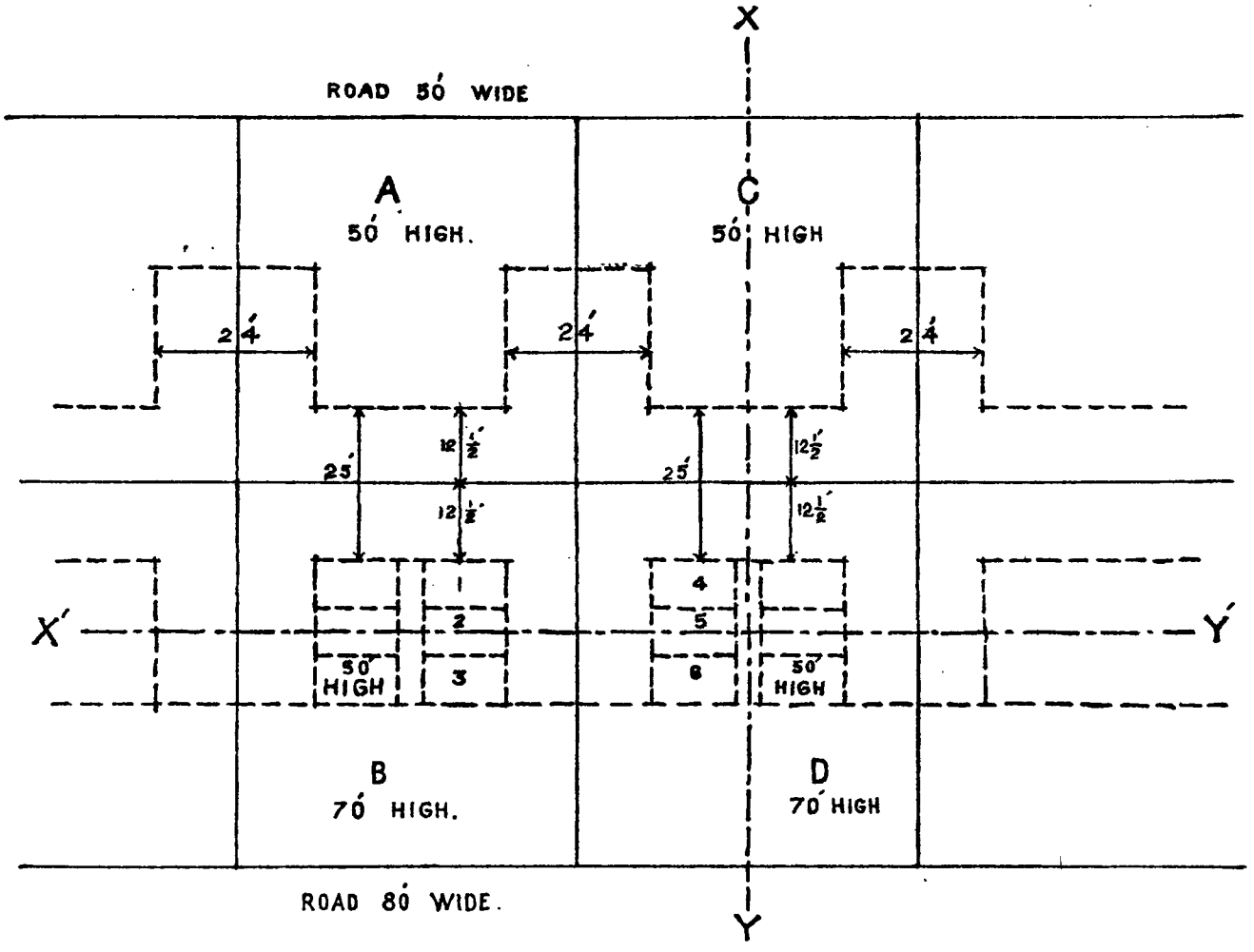


DIAGRAM №16 VIDE PARA 4.

SHEWING HOW $63\frac{1}{2}^{\circ}$ REAR AIR PLANE RULE REQUIRES ONLY 10' AT REAR OF BUILDING TO BE CUT DOWN TO 50' HIGH (IN DIAGRAM №15)

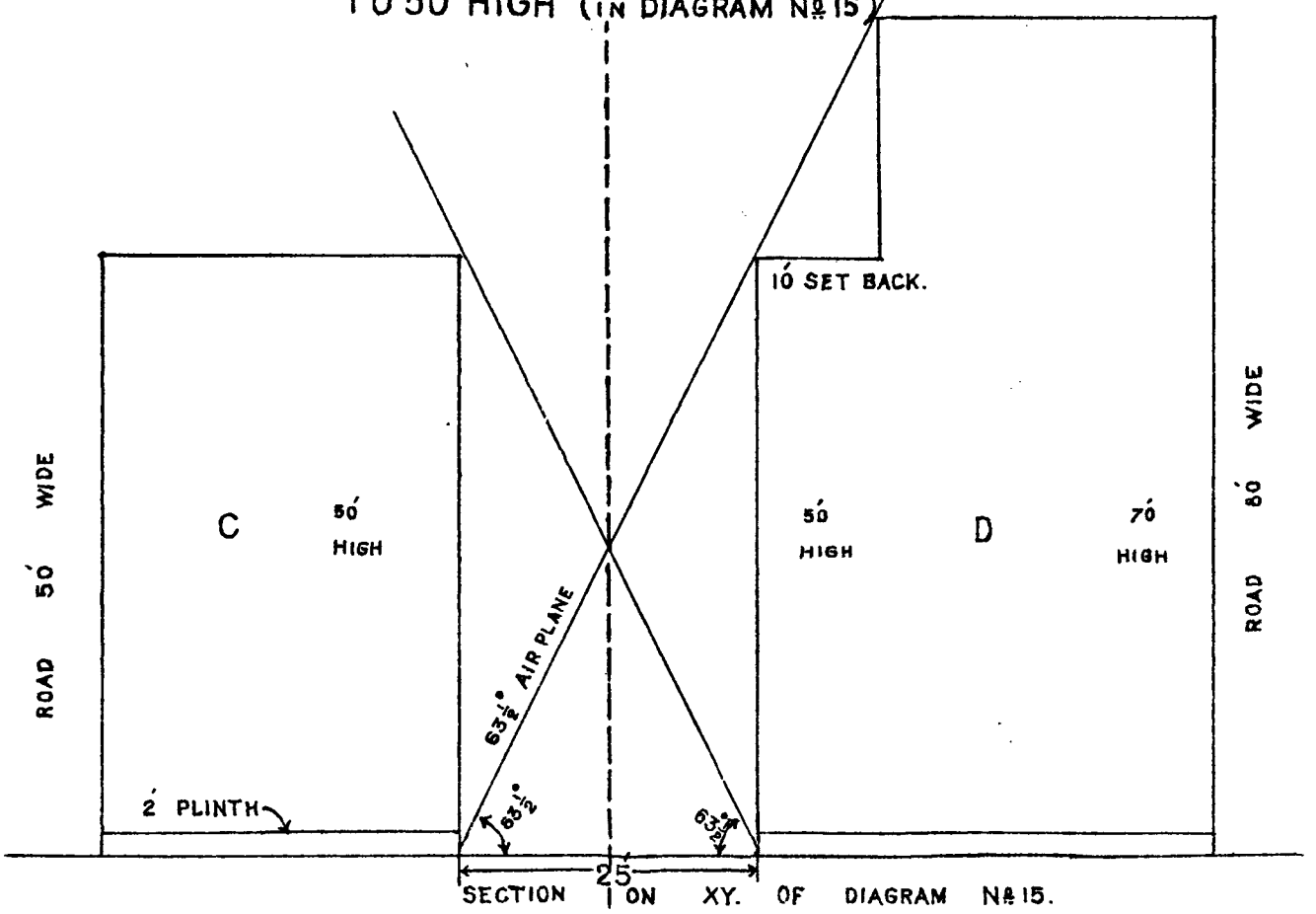
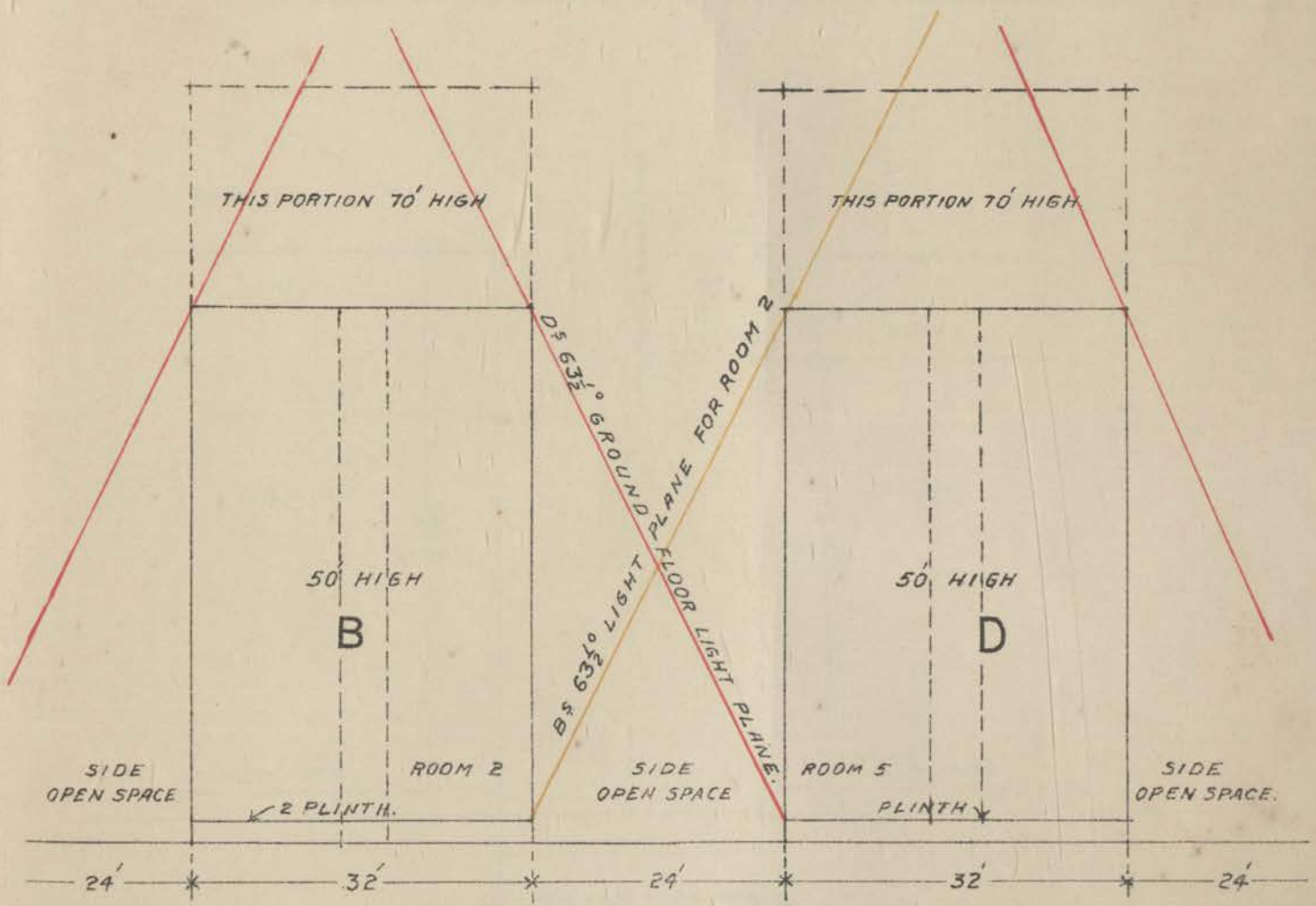


DIAGRAM No. 17 VIDE PARA

SHEWING HOW REAR EXTENSIONS
OVER 50′ HIGH WOULD ENCROACH ON
63½° LIGHT PLANE
AT SIDES OF BUILDINGS IN DIAGRAM No. 15.



SECTION ON X′.Y′. OF DIAGRAM No. 15.

DIAGRAM No. 18 VIDE PARA

SHEWING COMMON SIDE OPEN SPACE BETWEEN BUILDINGS OF UNEQUAL HEIGHT

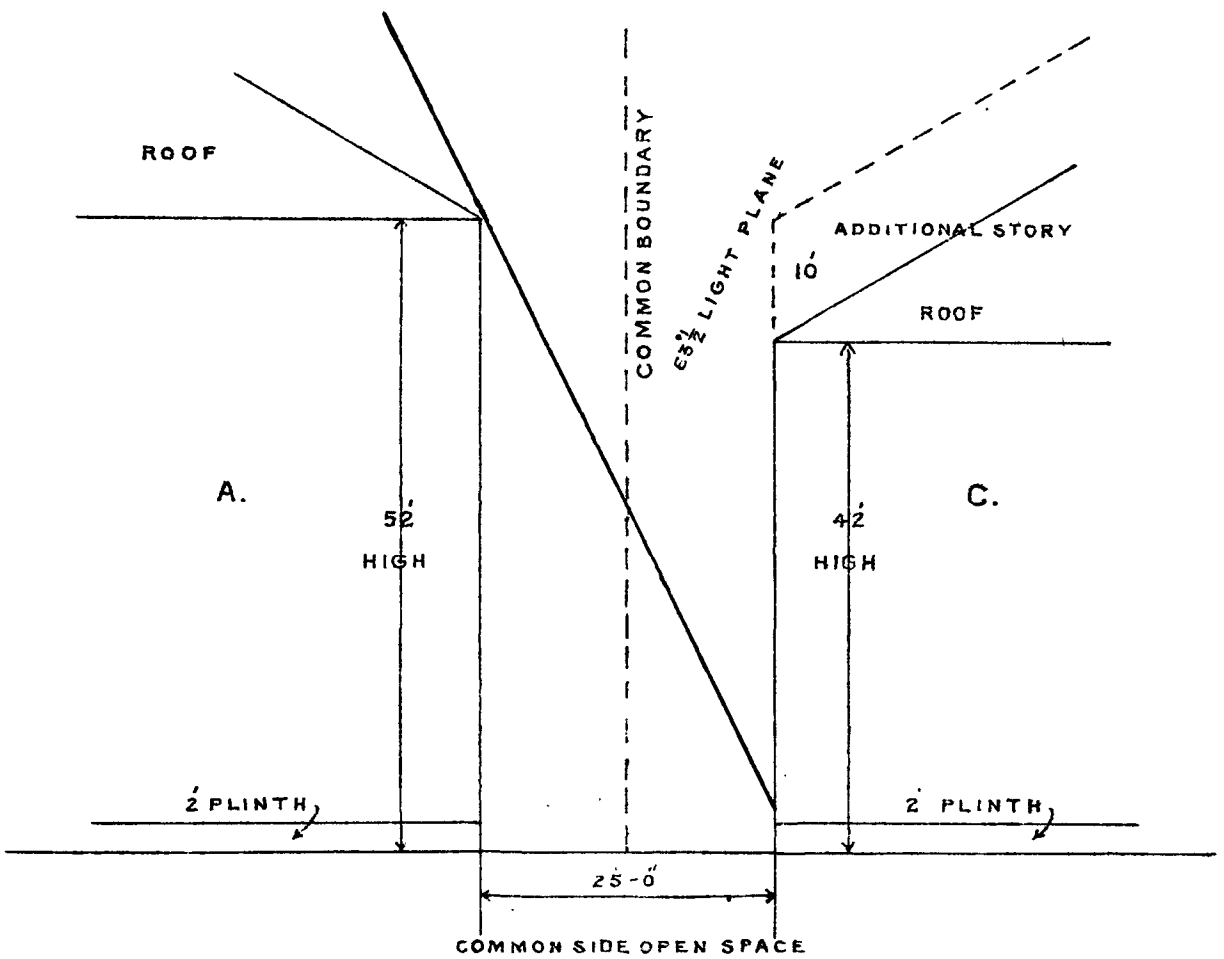


DIAGRAM No. 19 VIDE PARA

SHEWING INADEQUATE SIDE OPEN SPACE. BETWEEN BUILDINGS INVOLVING INFRINGEMENT OF LIGHT PLANE RULE BY LOWER HOUSE.

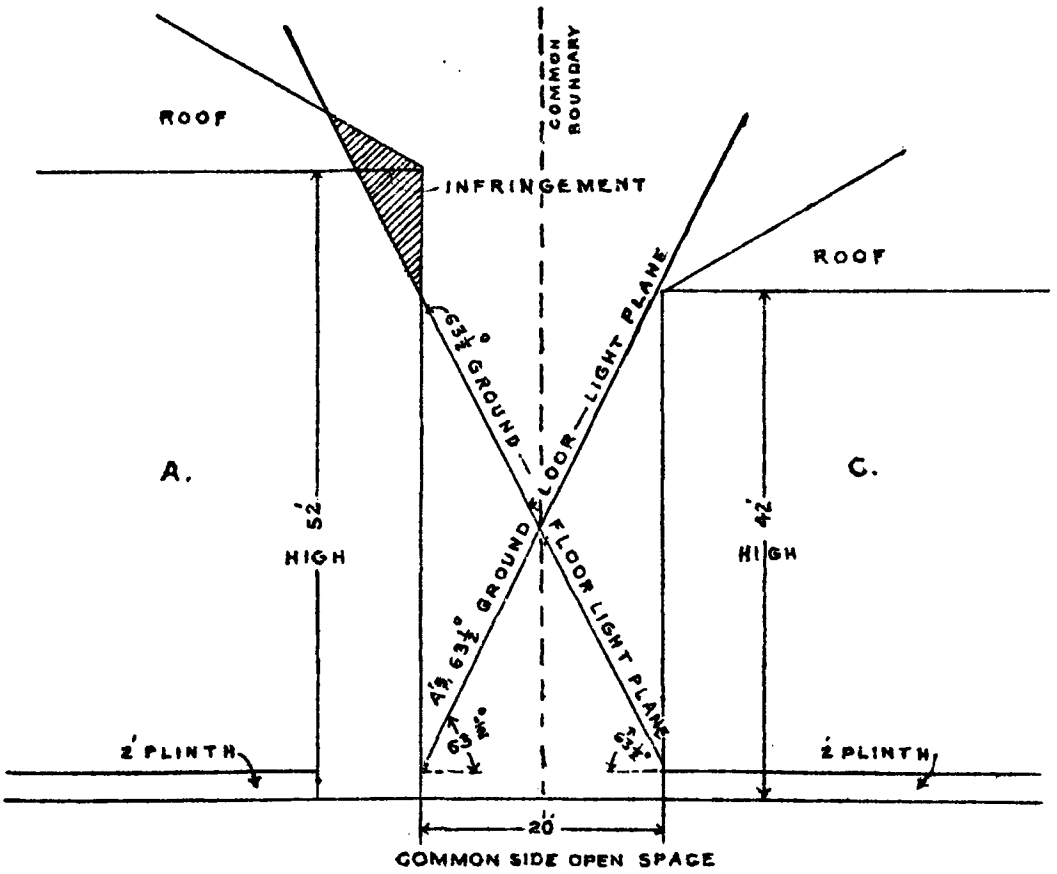


DIAGRAM Nº 20 VIDE PARA

SHEWING HOW 20′ SIDE SPACE IS ALLOWABLE IN THE CASE SHEWN IN DIAGM Nº 19 PROVIDED THERE IS A GODOWN ON THE GROUND FLOOR OF THE LOWER BUILDING

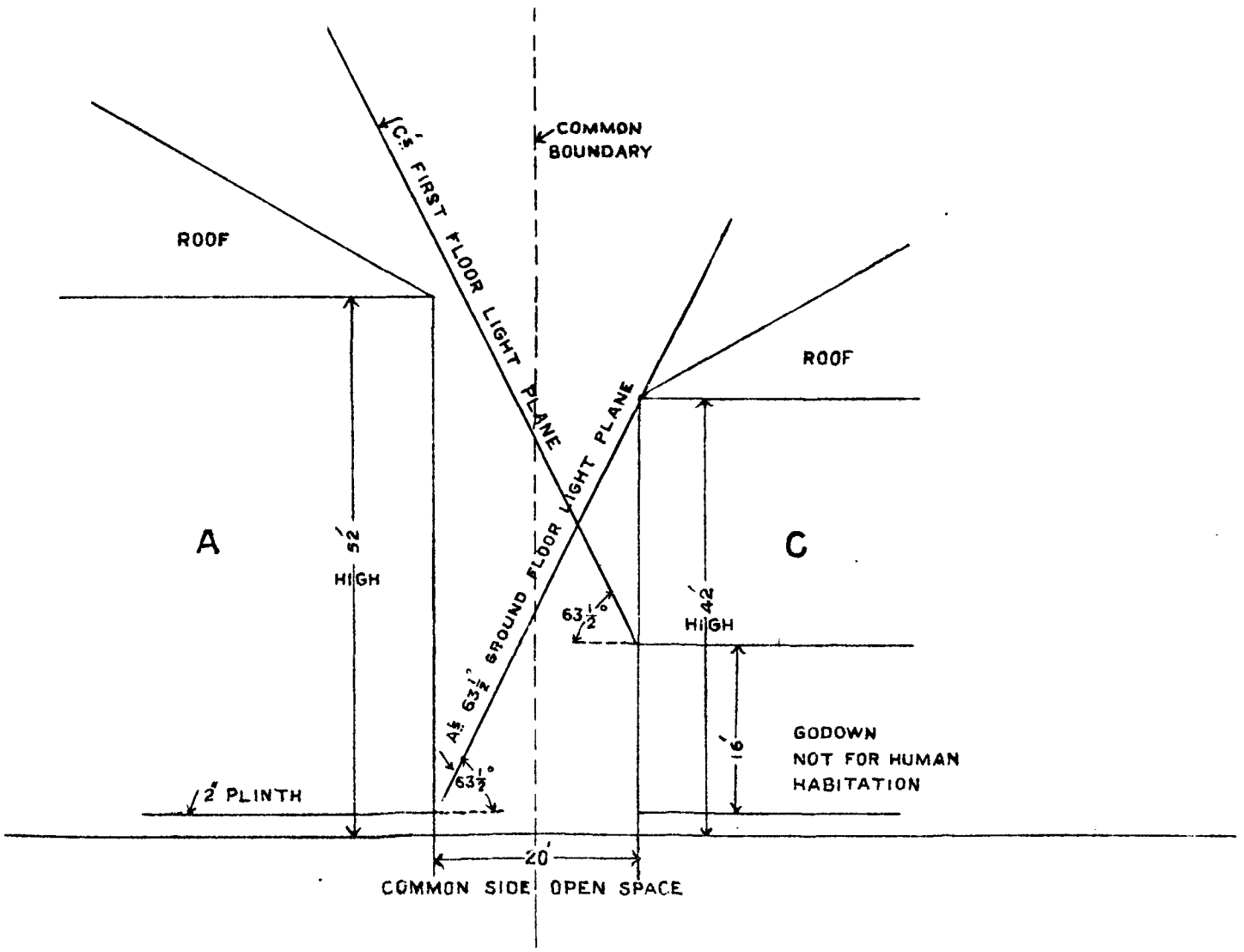


DIAGRAM No. 21 VIDE PARA

SHEWING COMMON SIDE OPEN SPACE BETWEEN BUILDINGS OF UNEQUAL HEIGHT WITH GODOWNS ON GROUND FLOOR

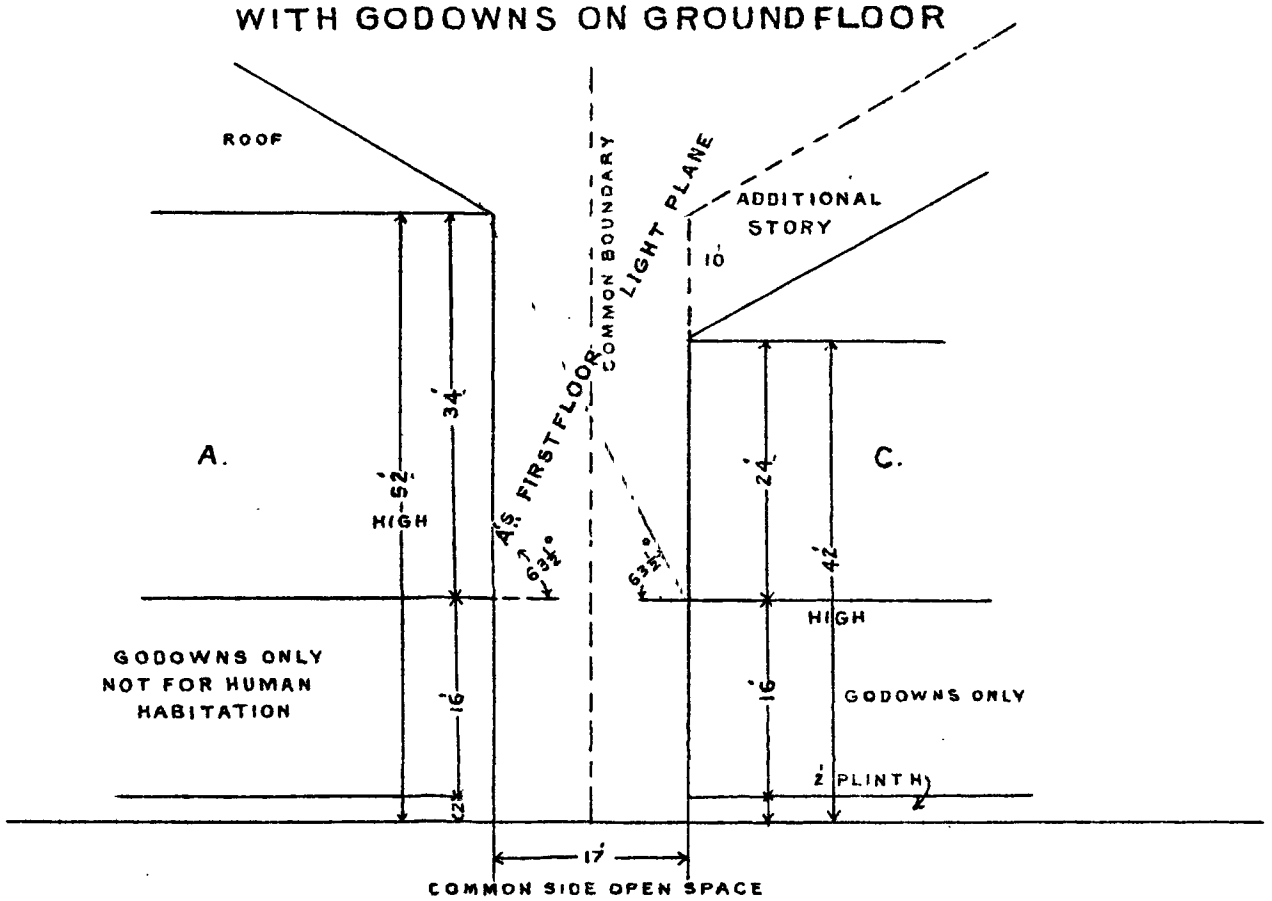


DIAGRAM No. 22 VIDE PARA

SHEWING PERMISSIBLE DEVIATION FROM STRICT REQUIREMENTS OF 63½° AIR PLANE RULE IN IRREGULARLY DEVELOPED AREAS

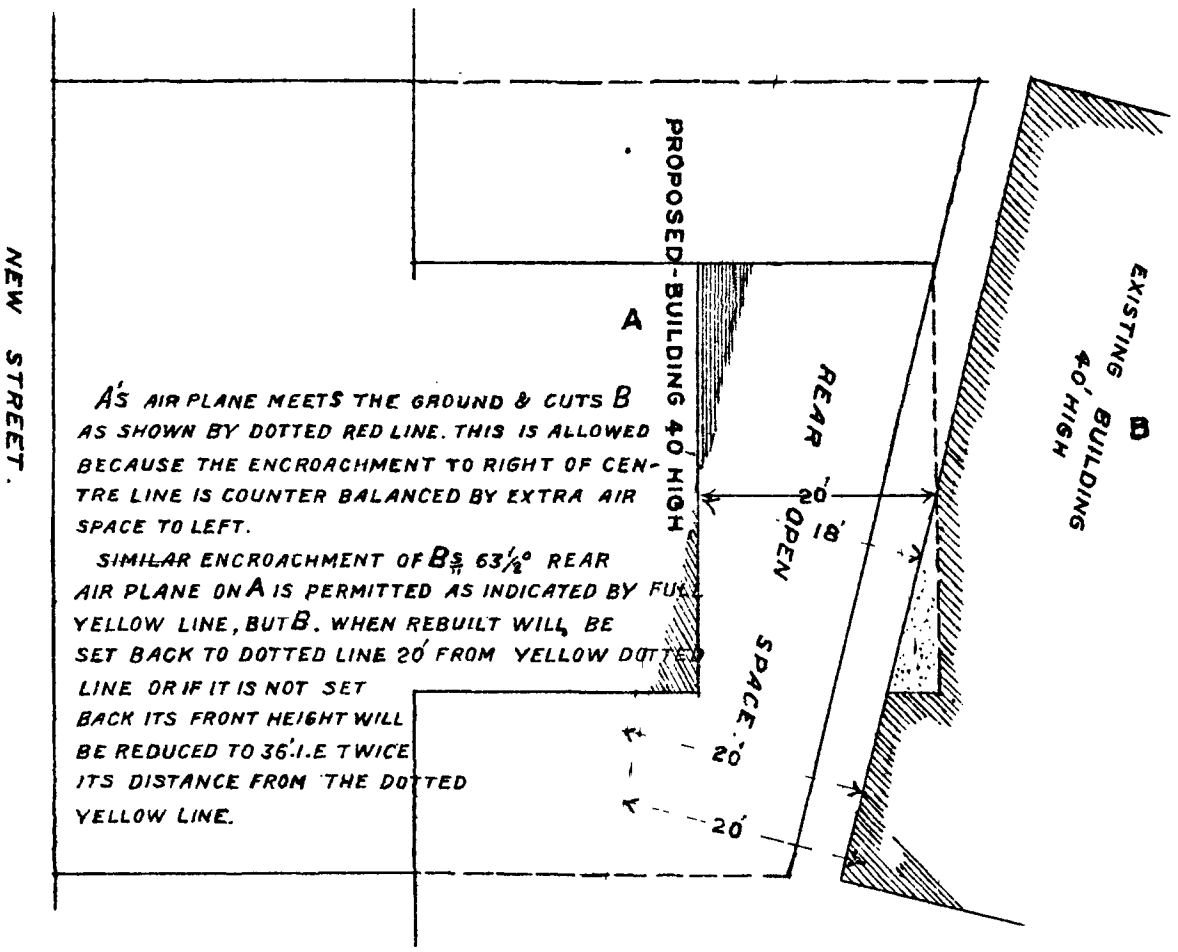
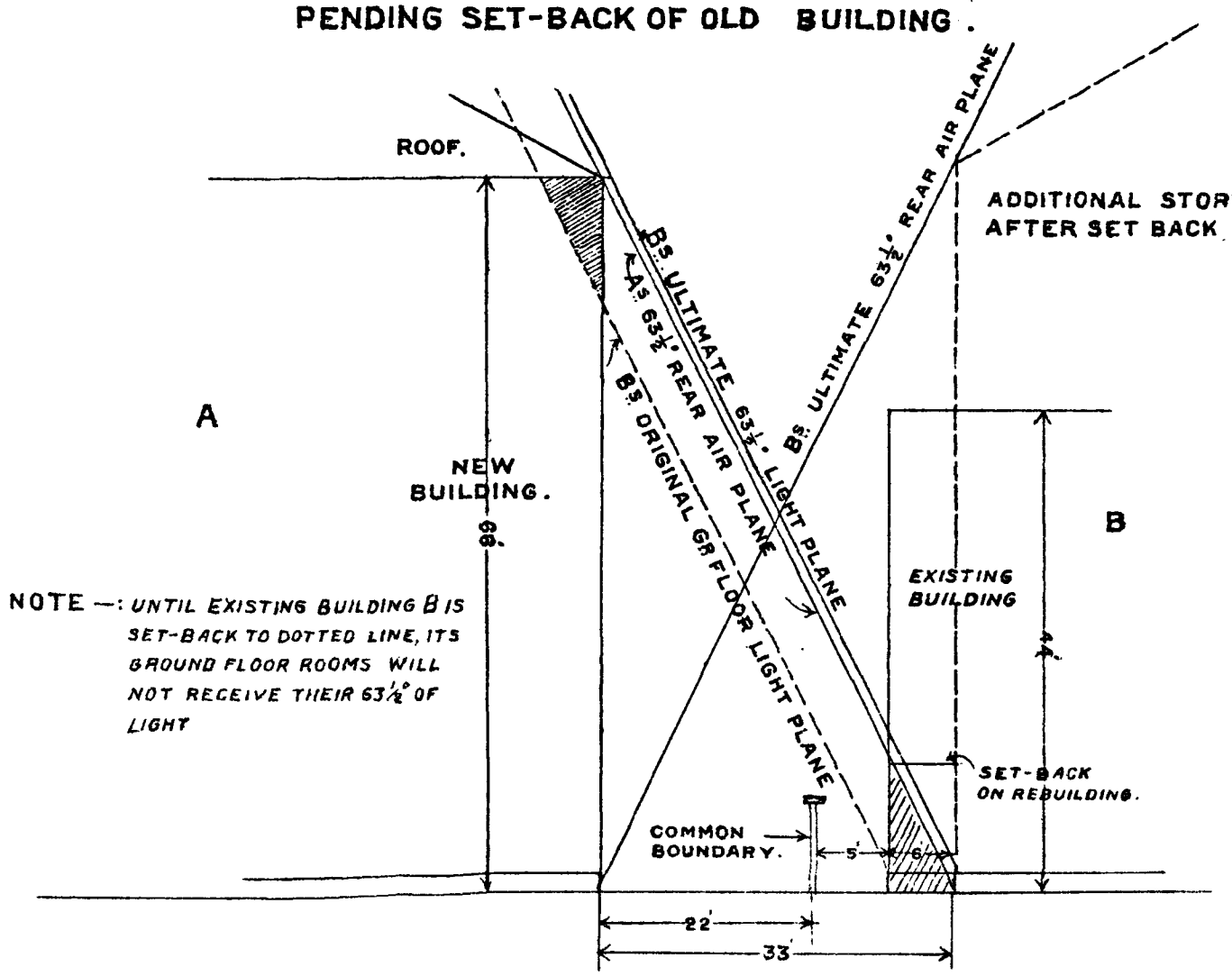

NEW STREET.
PROPOSED BUILDING 40' HIGH
A
B
EXISTING BUILDING 40' HIGH
REAR OPEN SPACE
20'
18'
20'
20'
A's AIR PLANE MEETS THE GROUND & CUTS B AS SHOWN BY DOTTED RED LINE. THIS IS ALLOWED BECAUSE THE ENCROACHMENT TO RIGHT OF CENTRE LINE IS COUNTER BALANCED BY EXTRA AIR SPACE TO LEFT.
SIMILAR ENCROACHMENT OF B'S 63½° REAR AIR PLANE ON A IS PERMITTED AS INDICATED BY FULL YELLOW LINE, BUT B. WHEN REBUILT WILL BE SET BACK TO DOTTED LINE 20' FROM YELLOW DOTTED LINE OR IF IT IS NOT SET BACK ITS FRONT HEIGHT WILL BE REDUCED TO 36'. I.E TWICE ITS DISTANCE FROM THE DOTTED YELLOW LINE.

DIAGRAM No. 23

SHEWING DEVIATION FROM LIGHT & AIR PLANE RULES TOLERATED TEMPORARILY PENDING SET-BACK OF OLD BUILDING.



NOTE —: UNTIL EXISTING BUILDING B IS SET-BACK TO DOTTED LINE, ITS GROUND FLOOR ROOMS WILL NOT RECEIVE THEIR 63½° OF LIGHT

DIAGRAM No. 24 VIDE PARA

SHEWING DEVIATION FROM LIGHT & AIR PLANE RULES

TOLERATED TEMPORARILY PENDING

SET BACK OF OLD BUILDING

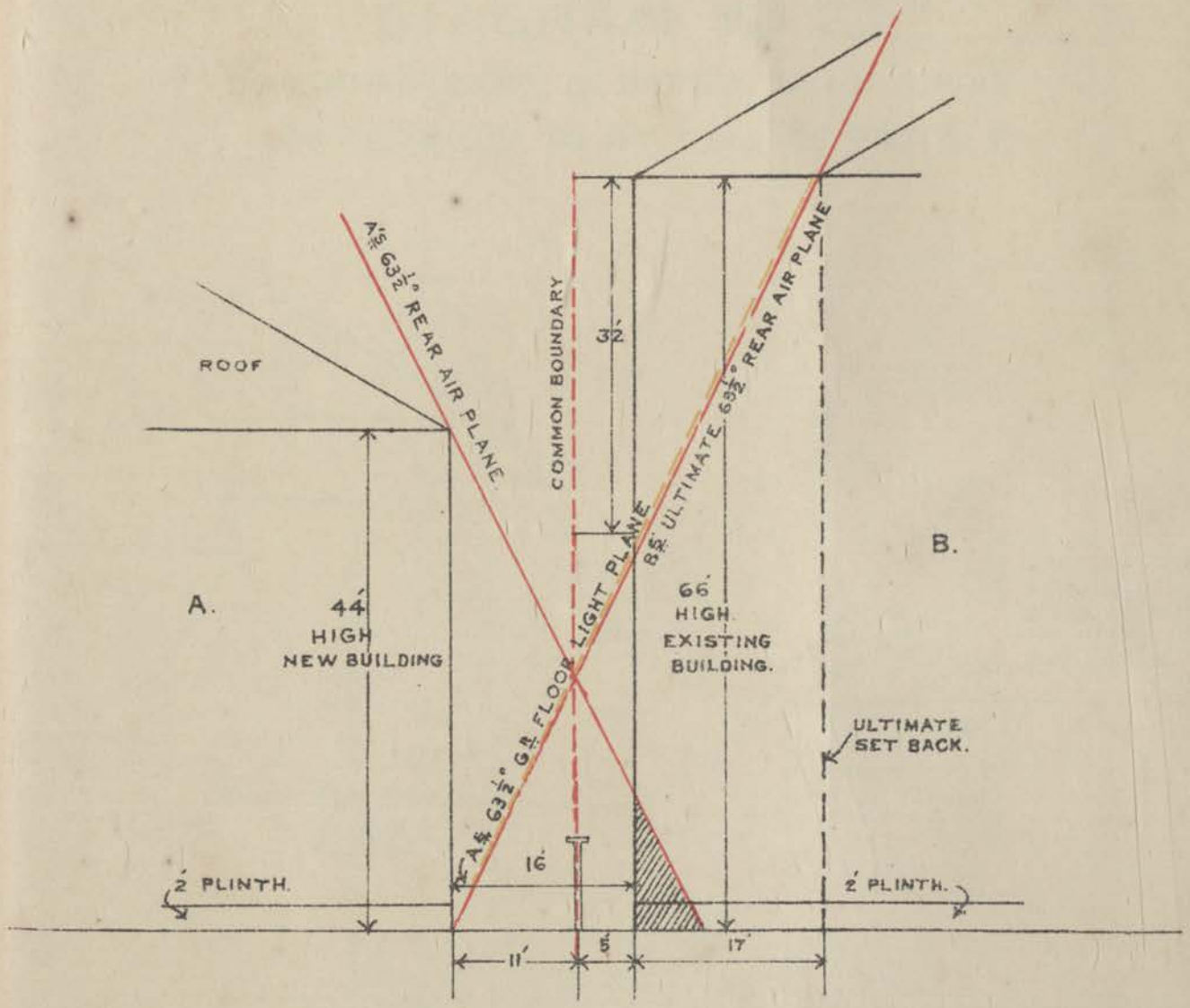


DIAGRAM No. 25.

SHEWING CASE IN PAPER MILL LANE

REFERRED TO AT END OF PARA 7.

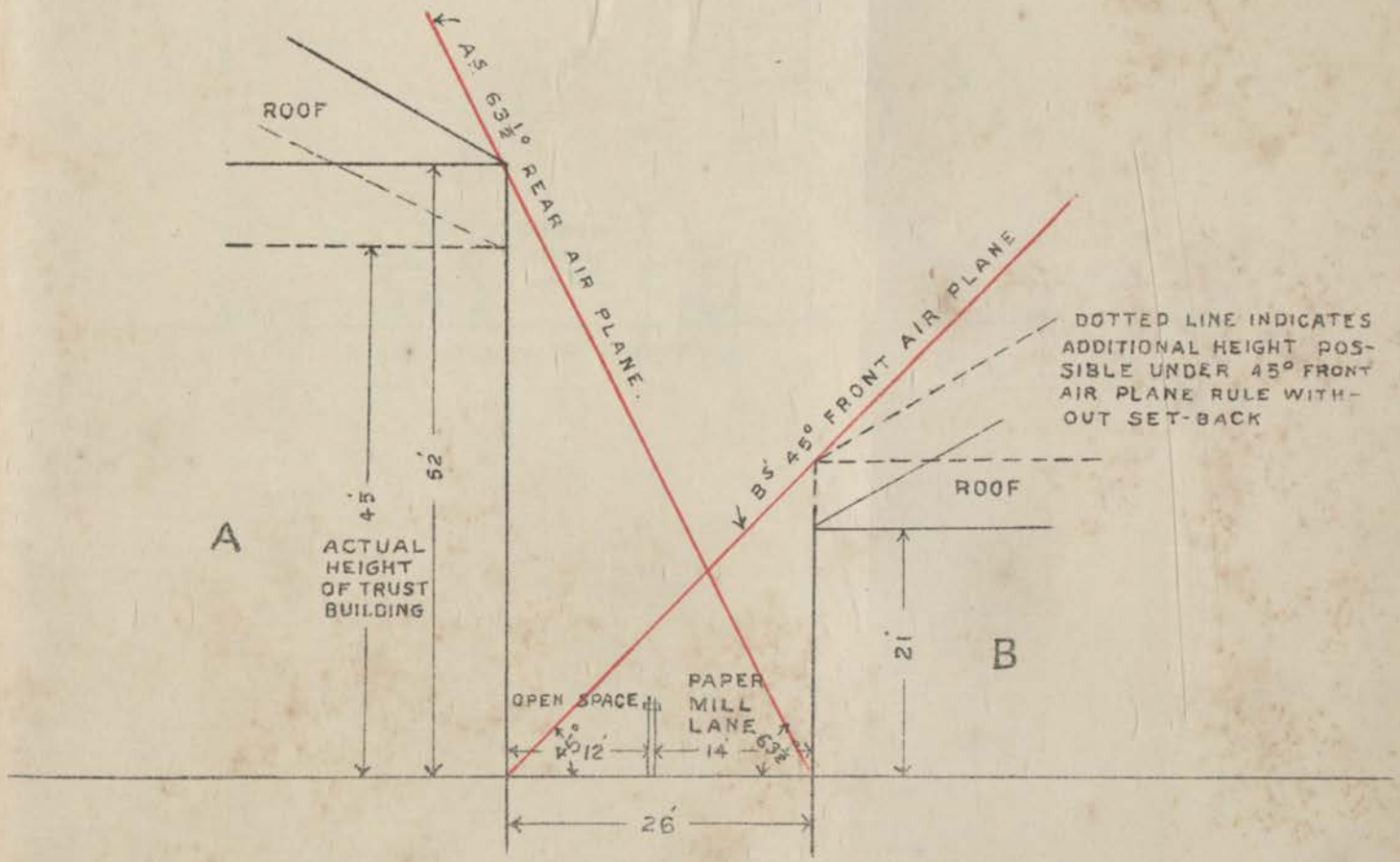


DIAGRAM Nº 26.

SHEWING EFFECT OF SETTING BACK B IN SAME CASE TO ENABLE A TO BUILD UP TO 68′ HEIGHT.

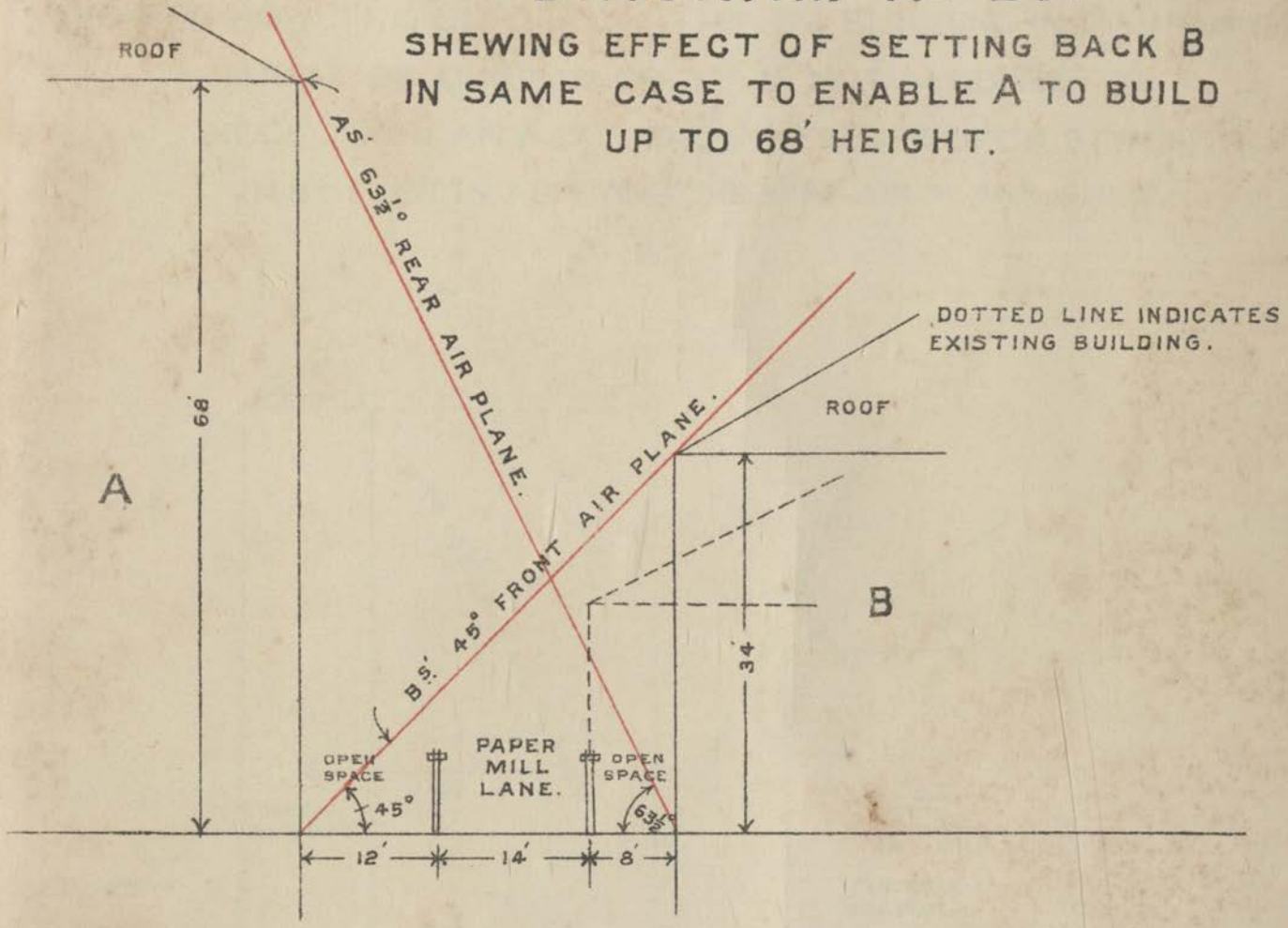
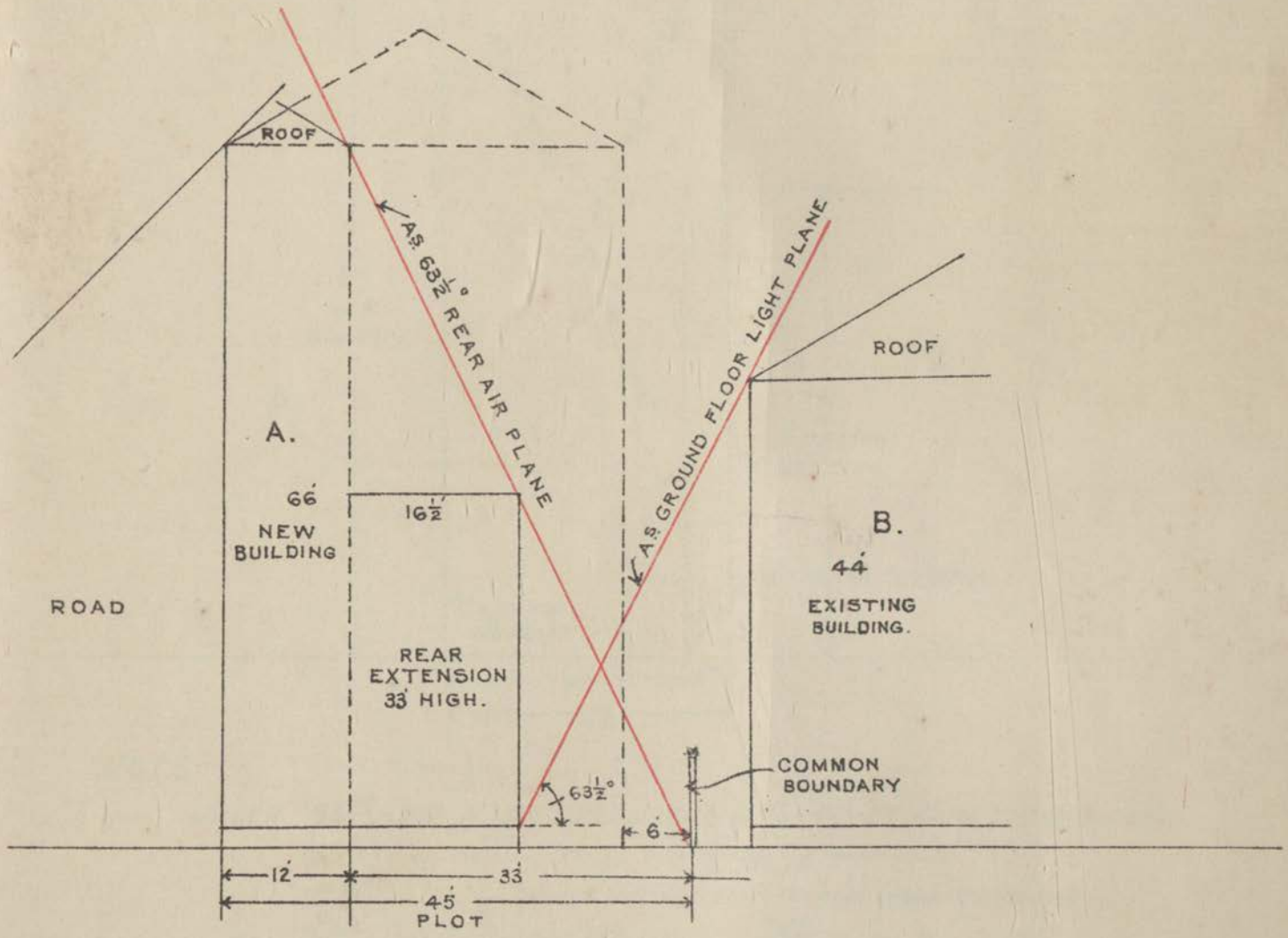


DIAGRAM No. 27 VIDE PARA

SHEWING HOW THE DEPTH OF THE 66' BUILDING IN DIAGRAM No. 23 MUST BE CURTAILED IF A IS NOT ALLOWED TO RECKON ON ANY EXISTING OR FUTURE OPEN SPACE IN B'S PLOT IN APPLYING THE REAR AIR PLANE RULE.



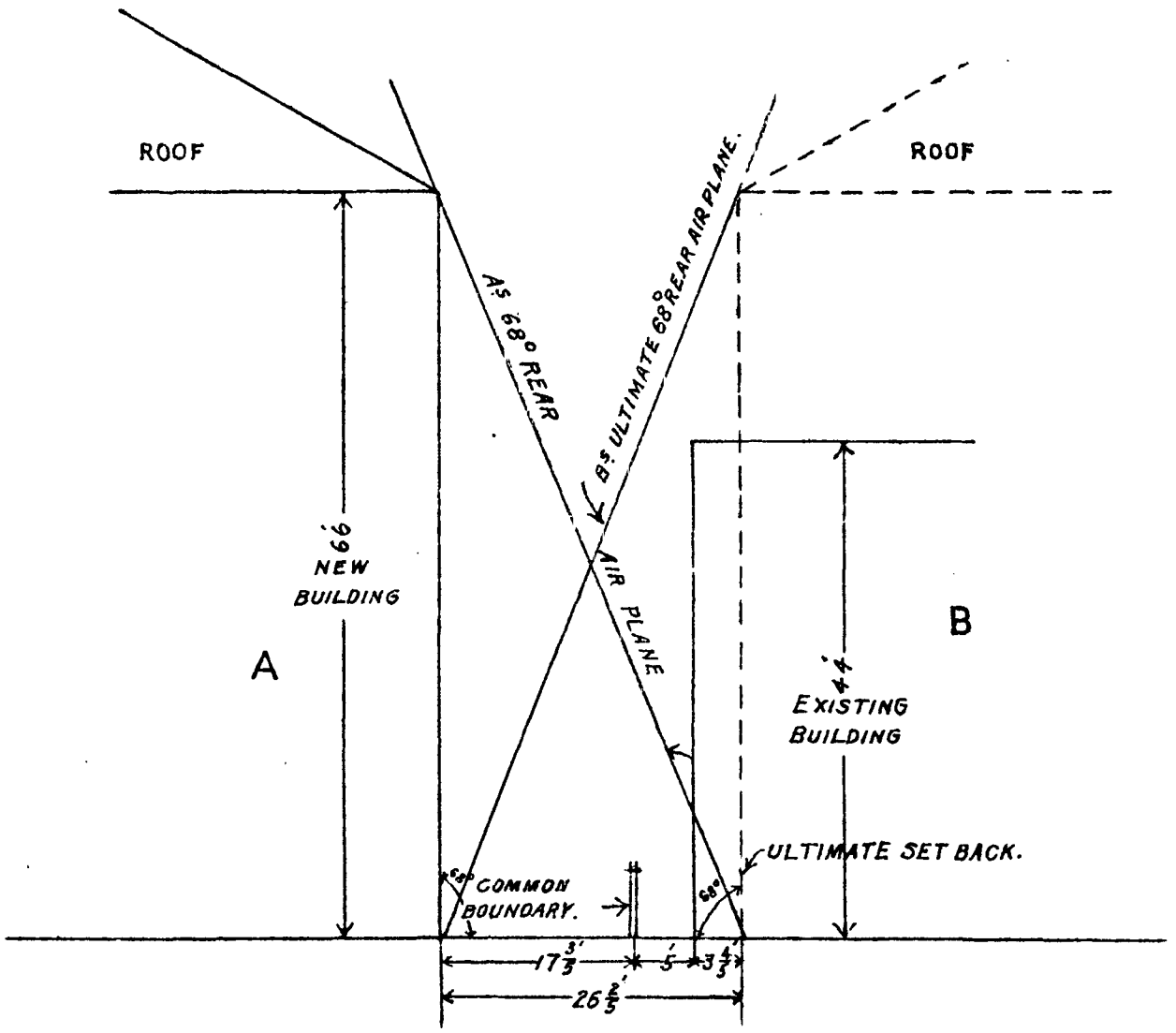
NOTE:-

IF A REDUCES THE HEIGHT OF HIS BUILDING IN REAR HE CAN BUILD UP TO THE POINT AT WHICH HIS 63½° GROUND FLOOR LIGHT PLANE JUST CLEARS B'S BUILDING

THE DOTTED LINE INDICATES THE EXTENT OF BUILDING ALLOWED BY MUNICIPAL BY-LAWS.

DIAGRAM Nº 28

SHEWING REDUCTION OF PRESENT AND ULTIMATE REAR OPEN SPACE BETWEEN BUILDINGS IN DIAGRAM Nº 23 CONSEQUENT ON SUBSTITUTION OF 68° REAR AIR PLANE FOR 63½° REAR AIR PLANE.



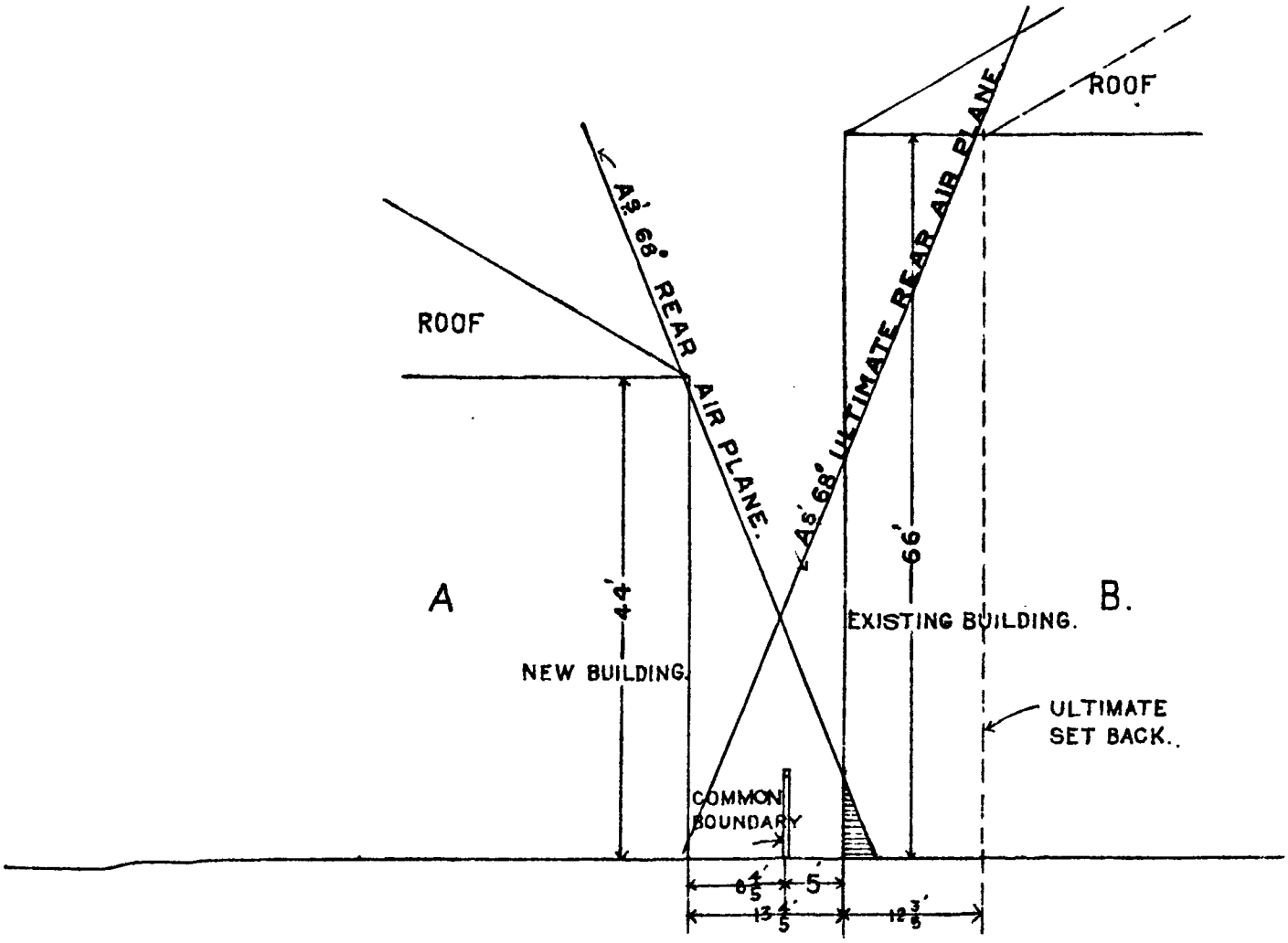
NOTE:-

UNDER 63½° RULE A CAN BUILD UP TO ½·66-¼·44=22' FROM COMMON BOUNDARY.
" 68° " " " " 2/5·66-1/5·44=17 3/5' " " "

"	63½°	"	B	MUST ULTIMATELY SET BACK TO	11' FROM COMMON BOUNDARY.
"	68°	"			8 4/5' " " "
"	63½°	"		SPACE BETWEEN BUILDINGS AT FIRST WILL BE	27'
"	68°	"			22 3/5'
"	63½°	"		SPACE BETWEEN BUILDINGS WILL ULTIMATELY BE	33'
"	68°	"			26 2/5'

DIAGRAM No. 29.

SHEWING REDUCTION OF PRESENT & ULTIMATE REAR OPEN SPACE BETWEEN BUILDINGS IN DIAGRAM No. 24 CONSEQUENT ON SUBSTITUTION OF 68° REAR AIR PLANE FOR 63½° REAR AIR PLANE.



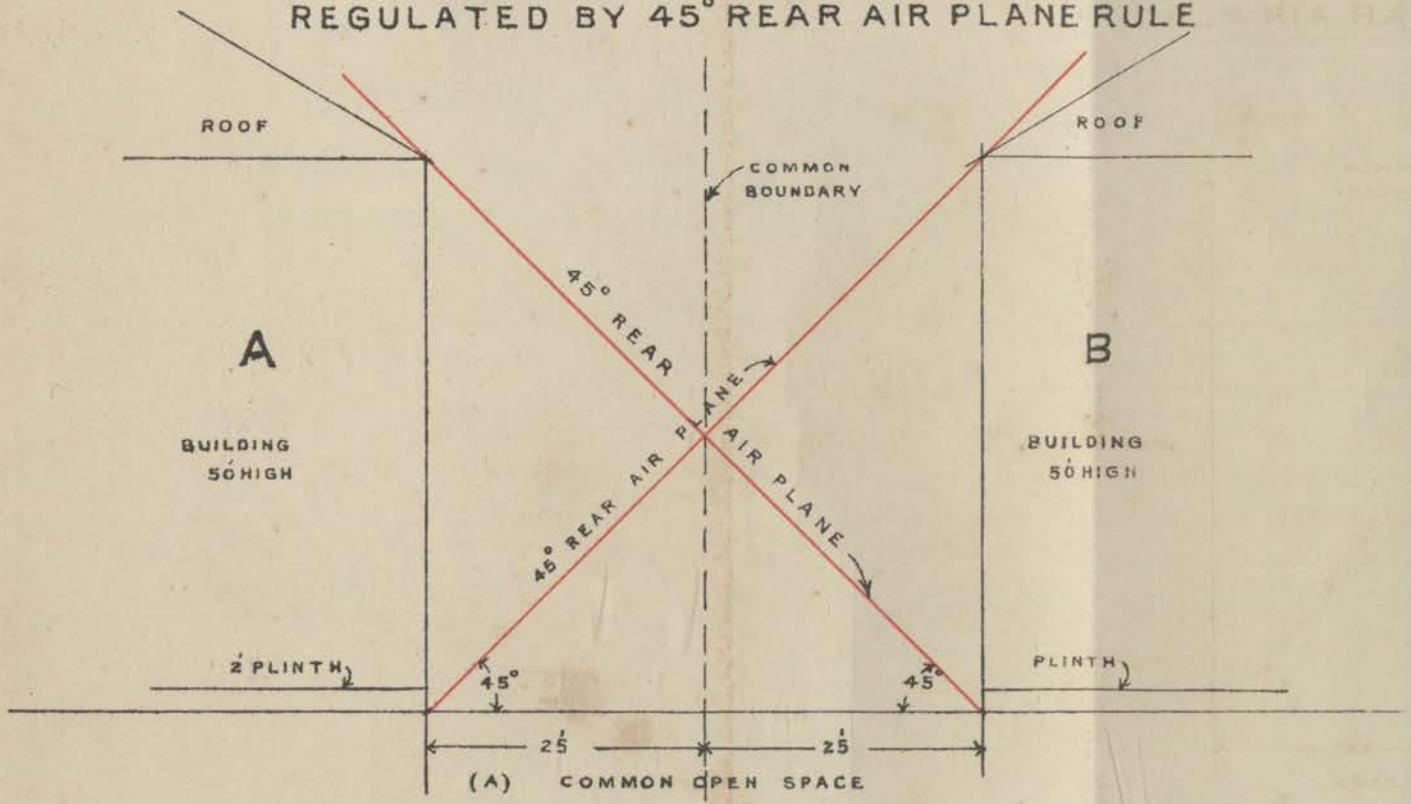
NOTE. UNDER THE 68° RULE THE DISTANCE BETWEEN THE LOWER BUILDING & THE COMMON BOUNDARY MUST BE $\frac{1}{5}\frac{TH}{VE}$ OF THE HEIGHT OF THE BUILDING, NOT $\frac{1}{4}\frac{TH}{VE}$ AS UNDER THE 63½° RULE. [V RULE IN PARA. 7]: AND THE ULTIMATE DISTANCE BETWEEN THE TWO BUILDINGS MUST BE $\frac{2}{5}\frac{TH}{VE}$ OF THE HEIGHT OF THE HIGHER BUILDING, NOT ½ AS UNDER THE 63½° RULE: $\frac{1}{5}\frac{TH}{VE}$ OF 44' = 8 4/5'
$\frac{2}{5}\frac{TH}{VE}$ OF 66' = 26 2/5'.

UNDER	63½°	RULE A CAN BUILD UP TO	11'	FROM COMMON BOUNDARY.
"	68°	" " " "	8 4/5'	" "
"	63½°	" B MUST ULTIMATELY SET BACK TO	22'	" "
"	68°	" B MUST ULTIMATELY SET BACK TO	17 3/5'	" "
"	63½°	" SPACE BETWEEN BUILDINGS AT FIRST WILL BE	16'	" "
"	68°	" SPACE BETWEEN BUILDINGS AT FIRST WILL BE	13 4/5'	" "
"	63½°	" SPACE BETWEEN BUILDINGS ULTIMATELY WILL BE	33'	" "
"	68°	" SPACE BETWEEN BUILDINGS ULTIMATELY WILL BE	26 2/5'	" "

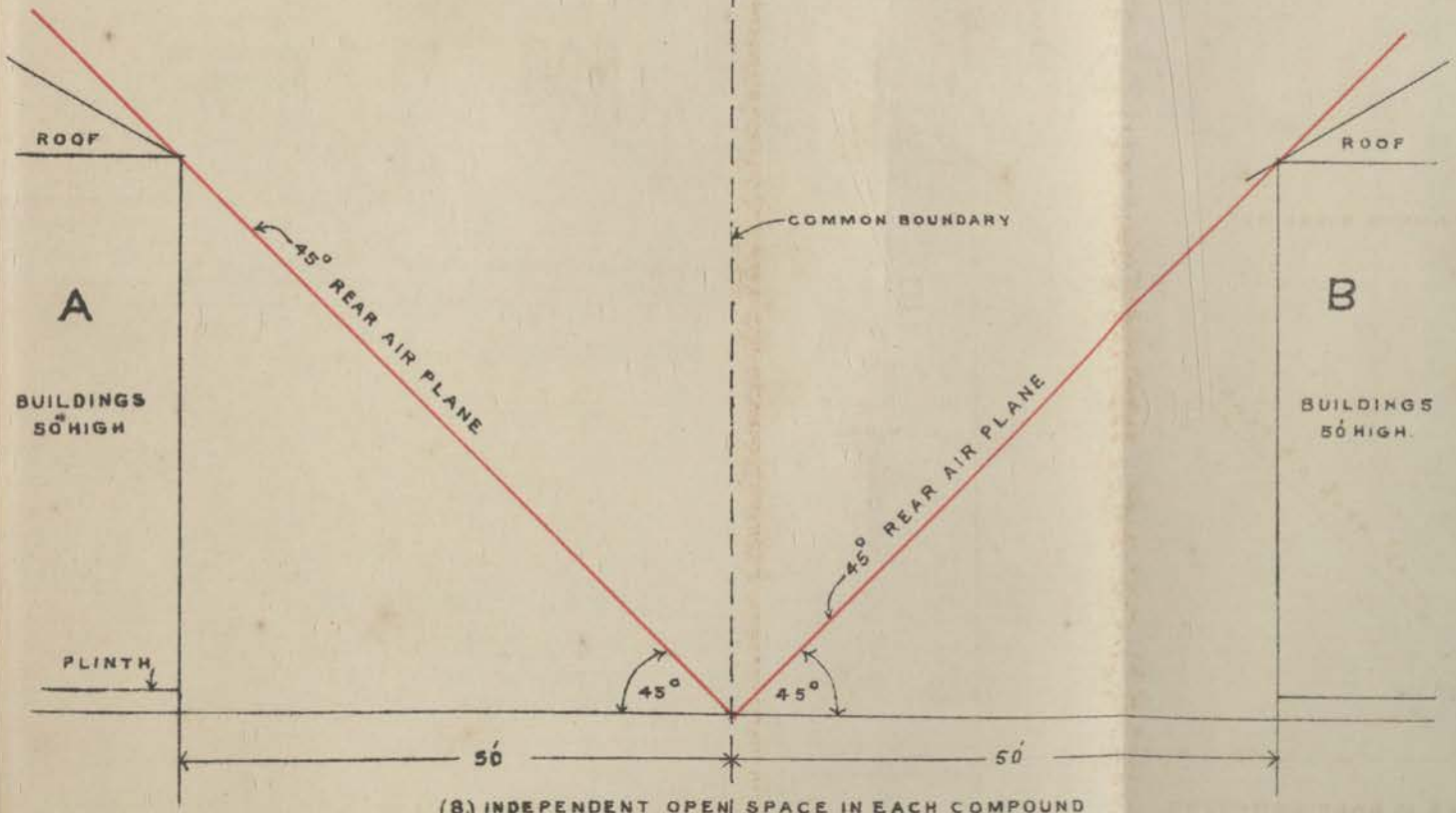
DIAGRAM No. 30 VIDE PARA

SHEWING REAR OPEN SPACE

REGULATED BY 45° REAR AIR PLANE RULE



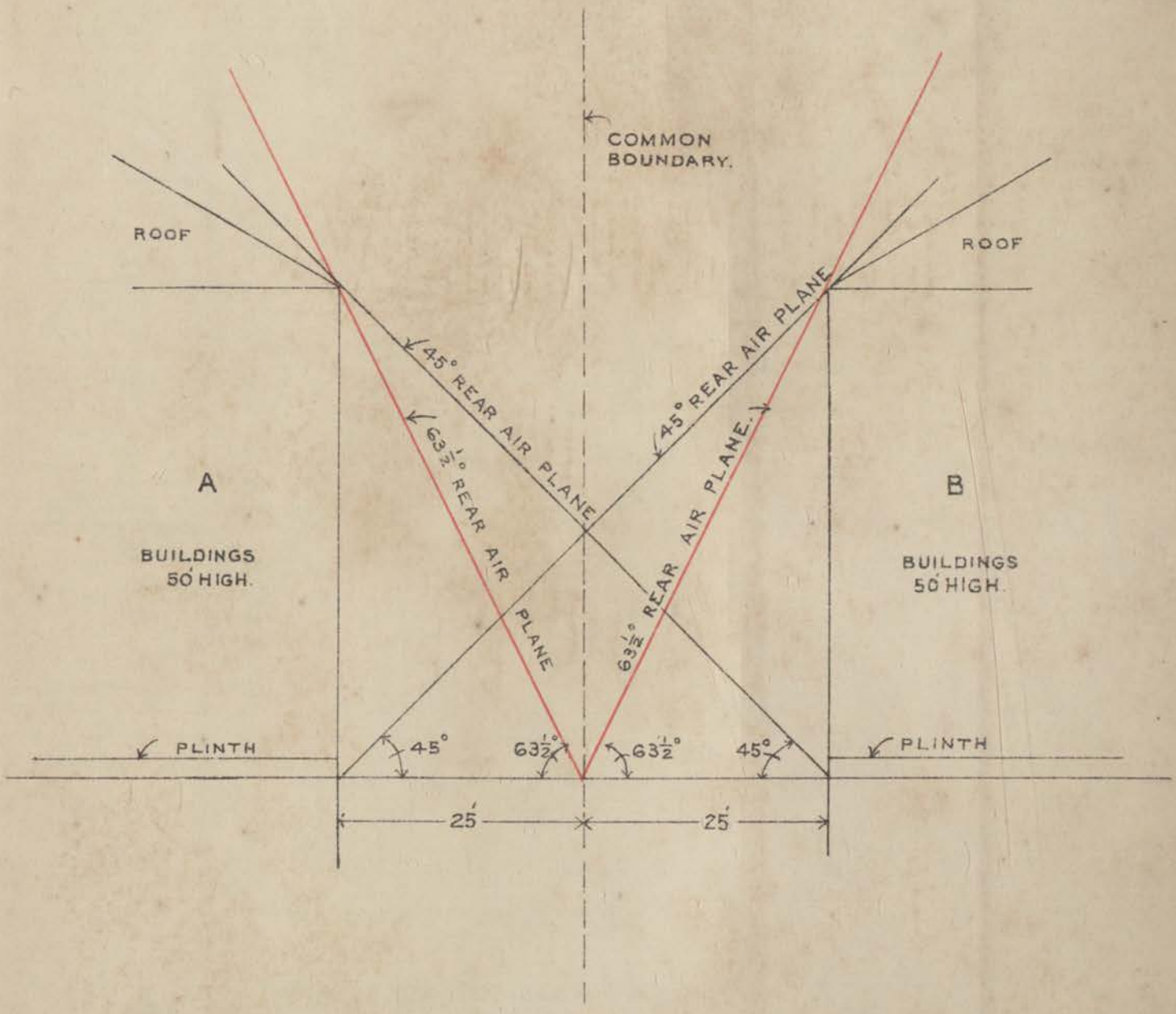
(A) COMMON OPEN SPACE



(B) INDEPENDENT OPEN SPACE IN EACH COMPOUND

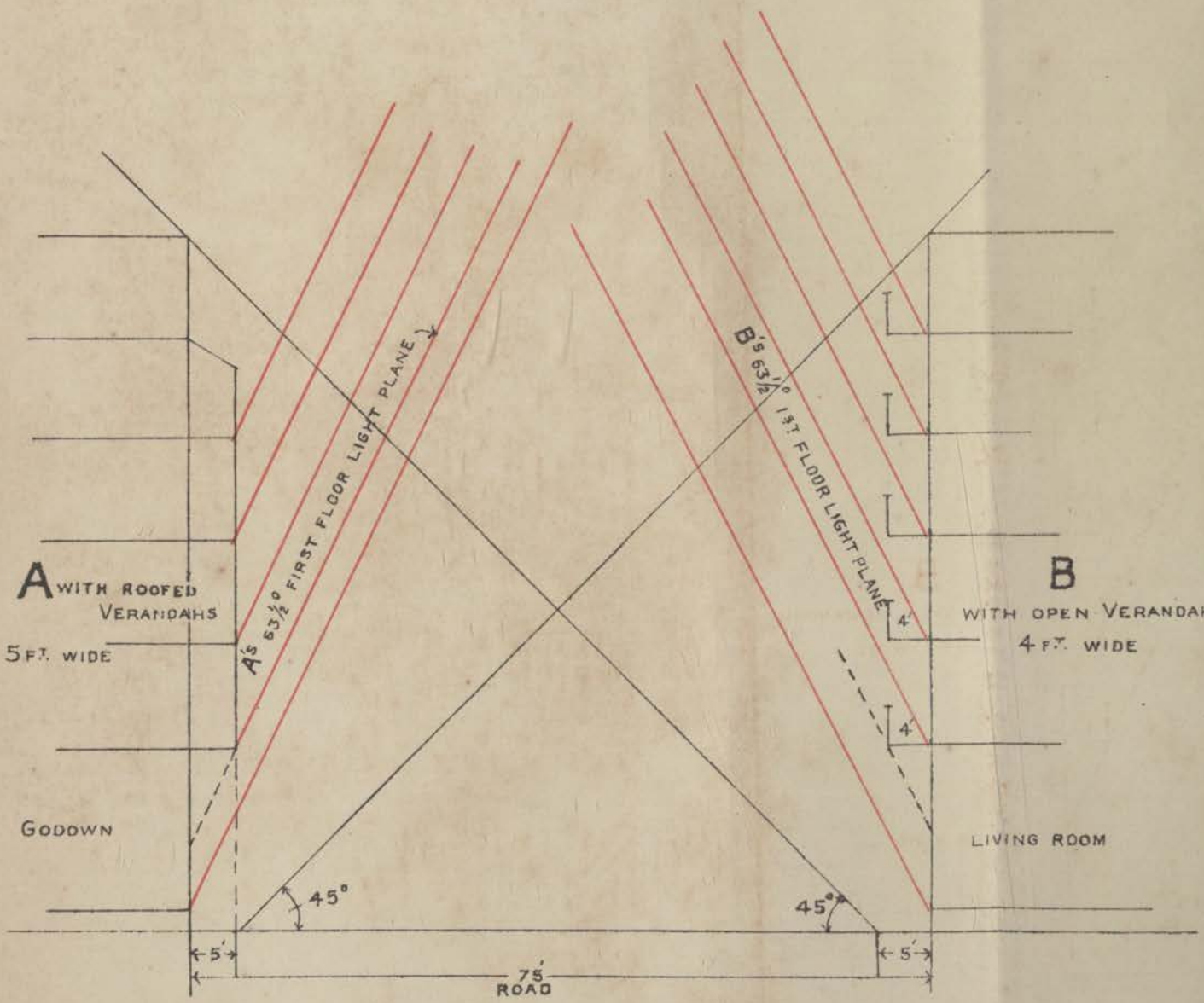
DIAGRAM No. 31 VIDE PARA

SHEWING EFFECT OF $63\frac{1}{2}°$ REAP PLANE RULE WITH INDEPENDENT REAR OPEN SPACES.



NOTE:— WHEN A & B ARE OF EQUAL HEIGHT THE EFFECT IS THE SAME AS IF THERE WERE A COMMON REAR OPEN SPACE SATISFYING 45° AIR PLANE RULE.

DIAGRAM No. 32



A: 5 FT. VERANDAH ALLOWED BECAUSE IT DOES NOT PROJECT OVER AIR PLANE WHILE THE ROOM OVER THE LIGHT PLANE OF WHICH IT PROJECTS IS A GODOWN NOT FOR HUMAN HABITATION.

B: 5 FT. VERANDAH NOT ALLOWED HERE (THOUGH IT WOULD NOT ENCROACH ON A's AIR PLANE) BECAUSE IT IS ABOVE LIGHT PLANE OF B's GROUND FLOOR ROOM WHICH IS USED FOR HUMAN HABITATION

LARGER OPEN SPACES REQUIRED WHERE LAND IS CHEAP.

11. *It should be particularly noted that the open space required by the air plane and light plane rules is the* minimum *open space reserved in Trust Estates. The Trust however recognise that it is desirable, wherever economically possible, to prescribe something very much greater than the minimum, and they only come down to the minimum in localities in which, on account of the high value of the land and the lack of accommodation sufficient to meet the demand for building space, it is desirable that the fewest possible restrictions should be put upon the available building space. In other localities they sometimes prescribe a minimum even twice as deep as that required by the* $63\frac{1}{2}°$ *air plane rule ;* i.e. (*vide Diagram No.* 30), *they apply the* 45° *air plane rule, not only to the front but to the rear of houses, and sometimes they require the* $63\frac{1}{2}°$ *rear air plane of each house to reach the ground* (*vide Diagram No.* 31) *within the compound of that house, which is what the Calcutta bye-laws require throughout the City, with the result that between every two lines of back to back buildings on roads not exceeding* 70′ *in breadth there is an open space equal to the mean of the widths of the* 2 *roads which they face. In the north of Bombay Island, where land is comparatively cheap, it is proposed to restrict the proportion of any plot that may be built on to one-third of the whole plot in addition to prescribing a minimum rear open space satisfying the* $63\frac{1}{2}°$ *air plane rule within the plot.*

APPENDIX C.

Précis of correspondence leading up to the Municipal Commissioner's Report, No. 2082 *of* 26*th April* 1901, *on the necessity of revising the Bombay Municipal Building Regulations and of the subsequent correspondence leading up to the passing of revised bye-laws in March* 1910.

1. By Corporation Resolution No. 8591 of 16th December 1897 a Committee was appointed to frame draft bye-laws " bearing on public health and sanitation generally and particularly for the prevention of the injurious effect on public health from defective sanitary construction and arrangement of buildings especially as regards ventilation," etc.

2. On 19th September 1900 this Committee reported to the effect that existing bye-laws and rules together with the rules for the improvement of insanitary houses under the Epidemic Diseases Act covered most of the subject matter of the resolution appointing the Committee, and that as the Health Officer and Divisional Officers were engaged in considering the question of the modification of the bye-laws, they thought it superfluous to frame any others themselves.

3. By Corporation Resolution, No. 8161 of 15th October 1900, the Committee's Report was forwarded to the Commissioner " for consideration in connection with the revision of bye-laws said to be now in hand."

4. This revision had been undertaken in accordance with Corporation Resolution, No. 4882 of 24th August 1899, requesting the Commissioner to report in consultation with the Executive Health Officer and the Executive Engineer what modifications, if any, were necessary in the building bye-laws in the interests of public health. The Municipal Commissioner reported on the subject in his No. 2082 of 26th April 1901 which is set at length below this précis.

5. With reference to this report the Corporation in their Resolution, No. 1685 of 13th May 1901, asked the Commissioner to have a set of draft bye-laws prepared after a conference with the Executive Engineer, the Executive Health Officer and some leading licensed Surveyors of Bombay or other professional men.

6. In July 1901 the Commissioner forwarded to the Corporation a letter from the Municipal Solicitors, who stated that with very few exceptions the Commissioner's suggestions could not be dealt with by bye-laws until the Municipal Act was amended and that most of the amendments had been provided for in the draft amendments of the Act already prepared. The letter was recorded by Corporation Resolution, No. 4795 of 22nd July 1901.

7. The draft amendments of the Act were under consideration till 1905, when an Amending Act (Bombay Act V of 1905) was passed.

8. In October 1906 Government enquired what progress was being made in revising the building bye-laws, pointing out that Bombay Act No. V of 1905 provided a basis for amendments of the bye-laws so as to render them efficient.

9. In May 1907 Government repeated this enquiry, pointing out that in 1901 the then Municipal Commissioner had described the existing building bye-laws as " notoriously inadequate " and that revised bye-laws had not up to that date been submitted.

10. Meanwhile the Municipal Executive were preparing a draft of revised bye-laws, and in March 1908 the Commissioner submitted it to the Corporation along with a printed Memo. of the Architects Association's suggestions on the draft and the Municipal Engineer's remarks on those suggestions.

11. The Corporation referred the matter to a Committee, who on 7th June 1909 submitted a print of the bye-laws as revised and finally settled by them in consultation with the Commissioner, the Executive Engineer, Mr. W. A. Chambers, representative of the Association of the Bombay Architects, and the Municipal Solicitor.

12. The draft bye-laws were approved by the Corporation and notified to the public, and, in due course, they were finally considered and forwarded to Government for confirmation on the 9th September 1909.

13. A few alterations were suggested by Government, the final draft was settled on the 24th January 1910, and the bye-laws were finally confirmed on the 19th March 1910.

Municipal Commissioner (Mr. Harvey's) Report No. 2082 of 26th April 1901.

"I have the honour now to report on the subjects referred to me by the Corporation resolutions noted in the margin, and to submit in the form of a note herewith forwarded a statement of the principal points in the present provisions relating to buildings which for sanitary reasons require early amendment. I have discussed these subjects at length with the Executive Engineer and the Executive Health Officer, and they agree with me as to the desirability of the alterations now suggested. In drawing up the statement referred to, I have made free use of the proceedings and report of the Calcutta Building Commission of 1897 and of the excellent rules and bye-laws which were the result of their enquiries and deliberations, and have also referred to the London Building Acts, the Model Bye-laws of the English Local Government Board, and other standard authorities. The Calcutta rules have been framed after full consideration of the conditions prevailing in Eastern cities, and have therefore a special value.

4882 of 24th August 1899.
6511 of 5th October 1899.
7102 of 16th October 1899.
8161 of 15th October 1900.

2. It is not necessary for me to make out a case for the amendment of building regulations which are so notoriously inadequate as those now in force in Bombay; a casual inspection of buildings erected under these regulations will be sufficient to convince anyone on this point. It is essential that the radical alterations proposed should be effected as soon as possible and especially so in view of the fact that within the next few years the Improvement Trust may be expected to clear large areas of insanitary buildings now existing, which should be replaced by buildings conforming to a much stricter standard of sanitation.

3. The applicability of new rules to buildings on sites already built on is no doubt a matter of difficulty; but, without some degree of stringency, little improvement is likely to be effected in the overbuilt areas in the native town. The new regulations should, therefore in my opinion, apply in their entirety to all buildings to be newly erected and to all buildings of which—

(*a*) not less than three-fourths of the existing posts or beams are removed; or

(*b*) not less than one-half of the aggregate number of posts and beams is removed; or

(*c*) not less than one-half of the area of external and cross walls is removed, and which it is proposed to reconstruct.

In other cases the general rule should be that all alterations and additions should be carried out in accordance with the Act and bye-laws, and should not be such as to cause any contravention of the same, exception being made in the case of necessary repairs not affecting the position or dimensions of the buildings. I have not proposed any rules for the improvement of existing buildings, as the powers given under the Epidemic Diseases Act will suffice so long as that Act subsists.

4. As regards underground rooms, a subject specially referred to by the Corporation, I have the honour to state, that in my opinion, the construction of these in domestic buildings should be altogether prohibited. In public buildings and buildings of the warehouse class they might be allowed, subject to proper provision being made for drainage of the soil, dryness and ventilation, and to the condition that they should be used for storage purposes only.

5. In addition to alterations for sanitary purposes only, the Corporation may perhaps wish that some measures should be taken to protect the best residential localities, such as Malabar and Cumballa Hills, by enacting that every building should be suitably detached and should have a compound of a certain size with reference to the area built over. There is no doubt that the appearance of the localities referred to is rapidly changing for the worse, and it is a pity that the beauty of the best part of Bombay should be sacrificed to the rapacity of the landowner."

Note to Letter No. 2082 of 26th April 1901.

Provisions regarding the ventilation of buildings.

Building sites.—The only restriction at present in force in respect of the relation of building sites to streets, made or projected, is contained in section 348 (1) (*b*)* of the Act, and this has in practice been found to be quite inadequate, while at the same time relieving large property holders of the obligation to provide sufficient accommodation for roads in the developing of their properties. It should be enacted that every new building or compound in which a building is to be erected must abut on a street of at least 40 feet in width and where no such street exists, a line must be laid down and the owners of the properties adjoining this line must leave sufficient land for the construction of the street. It should rest with the Corporation to decide whether a new public street should be laid out or not, and in the event of this being

* *Vide* Appendix D.

done there should be an obligation to acquire the land left vacant within a fixed period, say two years after the completion of the building, or in default to pay reasonable interest on the value. When the street is to be a private street, the owners of the land must be under an obligation to construct it within a reasonable time in each case. All applications to build, in which the above conditions are not satisfactorily provided for, should be liable to rejection.

2. *Height of buildings.*—The existing rules on this subject are contained in section 348 (1) (*e*)* of the Act and Bye-law No. 30. The principle affirmed by the bye-law in protection of existing building requires modification, and vested interests should be compelled to give way in favour of necessary sanitary measures. It seems desirable in the first instance to provide that except in the case of specially exempted buildings, such as public buildings or buildings for which special architectural features may be sanctioned, a certain maximum height should not be exceeded, and it is proposed that this should be fixed at 70 feet up to the tie beam of the roof or place where a tie beam would ordinarily be. The roof should not be allowed to rise above that at an angle to the frontage greater than 45°. Where the roof is a flat one a parapet three feet in height may be allowed above the maximum limit fixed. The height of buildings should be further limited according to the width of the street on which they abut, and modern expert opinion seems to be in favour of prescribing that the height of a house should not exceed the width of the open space in front of it. Rule 2 contained in Schedule XVII to the Calcutta Municipal Act of 1899 seems to be very suitable and is for facility of reference given below :—

"2. (1) If a building is situated at the side of a street, no portion of the building shall intersect any of a series of imaginary lines drawn across the street at an angle of 45 degrees with the plane of the ground, such lines being drawn from the street alignment on the side of the street which is the more remote from the building in question, at the level of the pavement or of the centre of the street."

"*Explanation.*—If a building be placed at the edge of the street, its height must not exceed the width of the street ; but if the building or one or more of its storeys be set back, the height of the building may be increased, subject to the condition that no portion of the building, after the height is increased, intersects any of the aforesaid lines.

"(2) In the case of any building which is re-erected in a street in existence at the commencement of this Act which is less than 25 feet width, the angle at which the lines referred to in sub-section (1) are to be drawn shall be 63½° instead of 45° :

"Provided that nothing contained in this sub-rule shall authorize the re-erection of any building so as to make it higher than any building which at the commencement of this Act is standing on the same site.

"(3) Notwithstanding anything contained in sub-rule (1) or sub-rule (2) the Corporation may, by order published in the *Calcutta Gazette*, declare that in any street in existence at the commencement of this Act, which is specified in the order, the erection of two-storeyed buildings not exceeding twenty-eight feet in height will be permitted without complying with the requirements of those sub-rules.

"(4) If a building is situated on a corner plot so as to abut upon more than one street, the height of the building shall be regulated by the wider of such streets so far as it will abut or abuts upon such wider streets, and also so far as it will abut or abuts upon the narrower of such streets to a distance of 40† feet from such wider street.

"The sub-section is not applied to buildings of the warehouse class erected in localities specially set apart for buildings of this class."

The Calcutta Building Commission point out that the 45-degree rule has been adopted by the Calcutta High Court as showing what amount of light and air is necessary for the convenient enjoyment of a house. It is recommended that the same standard should be adopted in Bombay. In the case of buildings on sites already built on the limit might be fixed at one and a half times the width of the street, where the height of buildings already existing on such sites is up to that limit at the time of the passing of the new rules.

3. *Exterior open spaces and interior open spaces.*—The regulations regarding these matters, on which the proper lighting and ventilation of rooms chiefly depend, are contained in section 348 (*j*) of the Act and Bye-law No. 31.‡ It must be obvious to anyone acquainted with the city that sufficient light and air cannot be obtained from gullies varying from 2 to 5 feet in width, and that where these gullies are used as open drains, as they usually are in Bombay, it is most undesirable to have openings on them. It is unfortunately impossible from a practical point of view to attempt to stipulate that no house shall have a depth of more than two rooms to be lighted and ventilated from open spaces on streets at the front and back respectively. Failing

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* *Vide* Appendix D.
† In Bombay 40′ is replaced by 80′ (*vide* 349B (4) in Appendix D.
‡ *Vide* Appendix D.

this, however, it is essential to make proper provision for the inner rooms, and it is proposed that the following main points should be observed in the case of domestic buildings :—

(*a*) The whole of at least one side of every room should be an external wall abutting on the open air or should abut on an interior open space.

(*b*) Such external wall when situated at the side of the building should abut on an open space of not less than ten feet in width extending along the whole length of the wall and belonging exclusively to the building. In this space no open drain except for rain-water should be allowed.

(*c*) Every interior open space referred to in (*a*) above should have a minimum superficial area of one-fourth of the aggregate floor area of all the rooms abutting thereon and a minimum width of eight feet, and should be open to the sky and free from any erections or encroachments of any kind. The height of any face of a dwelling abutting on such open space should not exceed twice the width of the space measured from such face to the opposite face ; but when a dwelling-house has more than two storeys, the storeys above the second should not be taken into account in applying this rule as to height if they are built on not more than two sides of the house.

(*d*) At the rear of the building there should be an open space exclusively belonging thereto of an aggregate area of not less than 150 square feet, of at least 10 feet in width, free from any erection, and extending laterally throughout the entire width of the building. The minimum distance from every part of such building to the boundary of any land or premises immediately opposite or adjoining thereto should be—

if the height of the building be	fifteen feet	.. fifteen feet.
,, ,, ,,	twenty-five feet	.. twenty feet.
,, ,, ,,	thirty-five or over	.. twenty-five feet.

This rule need not be applied in localities like Malabar Hill where most of the buildings are detached bungalows, nor should it be applied when at the rear of any building site there is a street or other permanently open space not less than 20 feet in width.

As in the case of the front part of a building the height of the part at the rear should be limited with reference to the width of the permanently open space on which it abuts, and it is proposed that, as provided in the London and Calcutta regulations, no part of the building should extend above a line drawn at an angle of sixty-three and a half degrees with the plane of the open space, at the level of the plinth, from the boundary of such open space furthest from the building.

4. *Height of rooms.*—The Act and bye-laws (*vide* section 348 (1) (*g*) and (*h*) and Bye-law 11) require a minimum height of 8 feet except in the case of rooms in the roof for which an average height of 7 feet is prescribed. The former limit should be increased to 10 feet measured from floor to ceiling.

5. *Superficial area of rooms.*—This should be increased from 80 to 120 feet.

6. *Area of opening for purposes of ventilation.*—The existing provisions are contained in section 348 (1) (*k*) of the Act and Bye-law 31 which require an aggregate opening of door or window space in each room equal to at least $\frac{1}{4}$ of the superficial area of that side of the room which faces the open space. It is proposed that doors should be left out of account and that windows or gratings equal to $\frac{1}{10}$ of the floor area of the room should be enforced.

7. *Width of streets.*—The same limit should be prescribed in the case of new private streets or accommodation roads as now obtains in respect of new public streets.

8. *Proportion of site to be built on.*—In the case of sites used for dwelling-houses the total area occupied by buildings should not exceed $\frac{2}{3}$ of the total area of the site.

9. *Overcrowding.*—The procedure prescribed in section 379 (1) of the Act is likely to be very cumbrous, and it is suggested that the Commissioner should be permanently invested with the powers he now possesses under the Epidemic Diseases Act, *viz.*, of requiring the abatement of overcrowding in any case by notice, and of enforcing compliance by forcible removal, with the assistance of the police and without reference to a Magistrate. The section should be made applicable not as at present to buildings but to rooms ; but some standard for guidance is required, whether the power is to remain with the magistracy or be vested in the Commissioner. It is proposed that no more than one family should be allowed to reside in each room ; that for each adult a floor space of 30 superficial feet and for each child under 10 a floor space of 15 superficial feet should be required, and that for each adult a cubical space of 300 feet, and for each child of under 10 a cubical space of 150 feet, exclusive of any part of the room more than 10 feet from the floor, should be enforced.

Provisions regarding Construction and Materials of Buildings.

1. *Floors.*—Muram, wood and earthen floors should be altogether prohibited, and power should be taken to determine the dimensions of timber or other material to be used for the support of floors.

2. *Walls and Roofs.*—Section 349 should, for sanitary reasons as well as for consideration of safety from fire, be applied to all inner as well as external walls and roofs. Powers should also be obtained to determine the dimensions of roof timbers.

3. *Dryness of Ground floor and Walls.*—It is believed that much of the unhealthiness of houses in Bombay is due to the large quantity of water which soaks into the soil from leaky gullies fed by taps constantly running. This subject was strongly commented on by Mr. Santo Crimp in his report on the drainage of Bombay. It is now proposed to adopt section 12 of Schedule XVII of the Calcutta Act Board is similar to the London rule and the model bye-law of the Local Government which on the subject and which runs as follows :—

" 12. (1) Every wall of a masonry building must have a damp-proof course at or above the level of the ground floor.

" (2) Such damp-proof course may consist of sheet lead, asphalte slates laid in cement, vitrified bricks or any other durable materials impervious to moisture."

Any material not distinctly specified in this rule should be subject to the approval of the Commissioner.

4. *Plinth.*—The level of the plinth should be taken as meaning the level of the lowest floor of a building.

5. *Receptacles for Refuse.*—It is desirable to prescribe that every house should be provided with suitable receptacles for refuse of description and material and on sites to be approved by the Commissioner in each case.

Provisions regarding Procedure to be followed in respect of Building Operations.

1. *Application to build.*—This subject is dealt with in sections 337, 338 and 342 of the existing Act, which are fairly satisfactory. If, however, the recommendations already made that every building site must abut on a street and that certain specified open spaces are to be preserved be accepted, provision must be made for full details of these being shown in the application to build. General power should also be reserved to call for any particulars which may be required for the purpose of ascertaining whether the application involves any breach of the Act or bye-laws.

2. *Disposal of applications to build.*—The Commissioner is at present bound under section 346 (1) to prescribe terms subject to which the building or work may be deemed to be approved. This is very unsatisfactory in practice and opens way to serious abuses and evasions, and it is absolutely necessary to enact that work shall not be undertaken until the plans, specification, etc., conform in every respect with the Act and bye-laws.

3. *Notice before commencement of work.*—The only provision in any way relating to this subject is Bye-law 39 which requires notice to be given before foundations are covered. It is, however, desirable to enact that written notice should be given to the Executive Engineer at least four days before the commencement of any building work.

4. *Procedure during construction.*—Considerable powers of inspection, etc., are given by sections 350-353 of the Act. These are, however, insufficient to prevent builders going on on the chance of subsequently escaping with a small fine or of the Municipality being unwilling to take the risk of a law suit. The Commissioner should have power, in case any work has been commenced without sanction or is being carried out in contravention of the sanction, given to stop the work with the assistance of the police if necessary, pending the orders of the Standing Committee as to its alteration or demolition.

5. *Certificate of completion.*—Within a reasonable time after the completion of any building the owner should be bound to give intimation to the Commissioner and should give all necessary facilities for inspection within a month after the intimation is given. If on inspection it is found that the work has been done in accordance with the sanction, and so as not to contravene any of the provisions of the Act or bye-laws a certificate permitting the occupation of the building should be given. If these conditions have not been fulfilled there must be power, as at the time of construction, to require the necessary alterations to be made.

Provisions regarding water-closets, privies, bath-rooms and water connections.

1. *Water connection.*—No connection should be allowed inside a house in an undrained district, as no system of cesspool carts could cope with the quantity of pipe water now brought into this city.

2. *Sites of privies, etc.*—Bye-laws 34 and 35, which relate to privies only, should be made applicable to water-closets also.

3. *Air spaces round water-closets.*—Sections 250 and 251 of the Act and Bye-law 36 should be made applicable to water-closets.

4. *Materials for floor, walls and roof of privies, etc.*—The Commissioner should have power to insist on the use of such materials as he shall prescribe, it being essential that the floor and walls should be constructed of materials impervious to moisture.

5. *General.*—Sections 247 *et seq.* of the Act leave it optional to owners to provide water-closet or privy accommodation. This should be amended so as to leave it to the Commissioner to decide in each case which should be required.

APPENDIX D.

PASSAGES IN ACT AND BYE-LAWS, ETC., REFERRED TO IN MAIN NOTE.

Extract from the original Bombay City Municipal Act, 1888.

Section 348 (*l*) (*e*).—No such building which abuts on a street of a less width than fifty feet, shall, without the written permission of the Commissioner, be erected to a greater height than one-and-a-half times the width of the street it abuts on.

Extracts from the Bombay City Municipal Act, 1888, *as modified up to the* 1*st May* 1912.

Section 3 (*W*).—" Street " includes any highway and any causeway, bridge, viaduct, arch, road, lane, footway, square, court, alley, or passage, whether a thoroughfare or not, over which the public have a right of passage or access or have passed and had access uninterruptedly for a period of twenty years ; and, when there is a footway as well as a carriage-way in any street, the said term includes both.

Definition of street.

Section 337.—(1) Every person who shall intend to erect a building shall give to the Commissioner notice of his said intention, in a form, obtained for this purpose under section 344, specifying the position of the building, intended to be erected, the description of building, the purpose for which it is intended, [a] its dimensions, [b] and the name of the person whom he intends to employ to supervise its erection.[b]

Notice to be given to Commissioner of intention to erect a building.

(2) In this chapter " to erect a building " means to newly erect a building, or to re-erect any building pulled down to the plinth, or any frame building of which only the framework is left down to the plinth, or to convert into a dwelling-house any building not originally constructed for human habitation, or to convert into more than one dwelling-house a building originally constructed as one dwelling-house only ; and a building so erected, re-erected or converted is called in this chapter " a new building."

Section 342.—Every person who shall intend—

(*a*) to make any addition to a building, or

(*b*) to make any alteration or repairs to a building, not being a frame-building, involving the removal or re-erection of any external or party-wall thereof or of any wall which supports the roof thereof, to an extent exceeding one-half of such wall above the ground-level, such half to be measured in superficial feet, or

(*c*) to make any alteration or repairs to a frame-building, involving the removal or re-erection of more than one-half of the posts in any such wall thereof as aforesaid, such half to be measured in superficial feet, or

(*d*) to remove or re-construct any portion of a building abutting on a street which stands within the regular line of such street,

shall give to the Commissioner, in a form obtained for this purpose under section 344, notice of his said intention, specifying the position of the building in which such work is to be executed,[*] the nature and extent of the intended work [a] and the name of the person whom he intends to employ to supervise its execution.[a]

Notice to be given to the Commissioner of intention to make additions, etc., to a building.

Section 348.—(1) (*b*) The erection of any such building in any part of the city in which the position and direction of the streets likely to be required in the future have not yet been laid down or determined shall, with the assent of the Standing Committee, be disapproved by the Commissioner, unless the site proposed for such building is, in the opinion of the Commissioner, such as, with reference to the positions occupied by the buildings, if any, already existing in the neighbourhood, will admit of the construction in the future of one or more new streets convenient for the occupiers of all the buildings in the neighbourhood and for the purposes of drainage,

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[a] Word repealed by Act V of 1905, section 44 is omitted.
[b] These words were added by Bom. V of 1905, section 44.
[*] Word repealed by Act V of 1905 is omitted.

water-supply and ventilation: provided that any person whose building is so disapproved may, by written notice to the Commissioner, require that the position and direction of the future streets in the vicinity of his intended building be forthwith laid down and determined, and if such requisition be not complied with within six months from the date thereof, may, subject to all other provisions of this Act applicable thereto, proceed with the erection of his building.

[a] (*l*) (*e*) In addition to any means of ventilation required by any bye-law made under this Act at the time in force, every such building intended to be used as a dwelling shall be so constructed that the whole of at least one side of every room thereof shall either be an external wall or abut on an interior open space. Such external wall, except where it faces a street of not less than fifteen feet in width, shall have between it and the boundary-line of the owner's premises an open space, extending throughout the entire length of such wall, at least two feet wide or, in the case of a chawl or building intended to form a range of separate rooms for lodgers, at least five feet wide. Such interior open space shall have an area equal to not less than one-tenth of the aggregate floor area of all the rooms abutting thereon and shall not be in any direction less than six feet across. And every open space, whether exterior or interior, required by this clause, shall be, and be kept, free from any erection thereon and open to the sky, and shall be and be kept open to access from each end thereof.

(*j*) In addition to any means of ventilation required by any bye-law made under this Act at the time in force, every such room shall be ventilated by means or doors or windows which open directly into the external air and have an aggregate opening equal to not less than one-fourth of the superficial area of the side of the room which faces an open space.

[b] 349-A. (1) Except with the written permission of the Commissioner, no building shall be erected or raised to a greater height than seventy feet as measured from the level of the centre of the street in front :—

Maximum height of building.

(*a*) in the case of a pitched roof, up to the tie beam of the roof, and,

(*b*) in the case of a flat roof, up to the surface of the roof.

(2) In the case of a pitched roof, the roof above that height shall rise at an angle of not more than forty-five degrees.

(3) In the case of a flat roof, a parapet of not more than three feet in height may be constructed above the maximum height specified in sub-section (1).

[c] 349-B. Subject to the maximum prescribed by section 349-A the height to which a building may be erected or raised shall be regulated by the width of the street on which it abuts in accordance with the following rules, namely :—

Height of buildings with reference to width of street.

(1) if the width of the street does not exceed twenty-six feet the building shall not be erected or raised to a height greater than one and one-half times the width of the street ;

(2) if the width of the street exceeds twenty-six feet but does not exceed forty feet the building shall not be erected or raised to a height greater than forty feet ; and

(3) if the width of the street exceeds forty feet the building shall not be erected or raised to a height greater than the width of such street;

(4) Where the building abuts upon more than one street, its height shall be regulated by the wider of such streets so far as it abuts upon such wider street and also to a distance of eighty feet from such wider a street, so far as it abuts upon the narrower of such streets :

Provided that, if the face of the building is set back from the street at any height not exceeding the height specified in sub-section (1), sub-section (2), or sub-section (3), as the case may be, such building may be erected or raised to a height greater than that so specified, but not so that any portion of the building shall intersect any of a series of imaginary straight lines drawn from the line of set-back, in the direction of the portion set back, at an angle of forty-five degrees with the horizontal.

Proviso in case of set-back.

Old bye-law No. 31 *under Bombay City Municipal Act.*

Every person who shall erect a new dwelling-house shall so construct such dwelling-house that the whole of at least one side of every room thereof intended to be inhabited shall either be an external wall abutting on the open air or abut on an in-

Open spaces around dwelling-house.

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[a] The original clause (*e*) has been deleted by Bom. V of 1905, section 51 (*b*), and the subsequent clause of section 148 (*l*) re-numbered accordingly.

[b] Section 449-A was inserted by Bom. V of 1905, s. 52.

[c] Section 349-D was inserted by Bom. V of 1905, s. 52.

terior open space having an area equal to not less than one-tenth of the aggregate floor area of all the rooms abutting thereon, and being not less in any direction than *six feet* across.

He shall provide between at least two of the external walls and the boundary line of the owner's premises, except where either of such walls faces a street of not less than *fifteen feet* in width, an open space extending throughout the entire length of such wall at least *two feet* wide. He shall cause every interior open space required by this bye-law to be constructed and kept free from any erection thereon and open to the sky, and no cornice, roof or weather shade shall project or overhang the said open space more than *six inches* on any side thereof: provided that such connecting passages may be allowed, as to the Commissioner shall seem necessary, such passages being open on one or both sides.

New bye-law of 1910 *defining "Construction work on a building."*

The expression "Construction work on a building" shall include not only the erection of a building as defined in sub-section (2) of section 337 of the Act, but also the erection of a building and the execution of any such work as is described in section 342 of the Act:

Provided that in the case of any work undertaken under section 342 (*d*) this definition shall, if the set-back be not taken, apply only to the extent to which the work is covered by section 342 (*b*) or (*c*) and, if the set-back be enforced, it shall not apply to any portion of the building other than the portion under reconstruction.

New bye-law No. 41 *of* 1910.

Open spaces abutting on rooms, etc.

41. (1) Every person who shall undertake construction work on a building intended to be used as a dwelling shall cause the whole of at least one side of every room included in such work and intended for human habitation to abut—

On an exterior or on an interior open space of the width or dimensions, and fulfilling the conditions hereinafter prescribed for such open spaces, respectively, or

On an open verandah opening on to such an exterior or interior open space as aforesaid.

(*a*) Every such exterior open space shall, subject as hereinafter provided, extend throughout the entire length or depth, as the case may be, of the building on the side on which such room so abuts, and shall, unless the same is a street, be maintained for the benefit of such building exclusively, and its minimum width shall be in accordance with the following scale, varying according to the variation (if any) in the height of such building where it immediately adjoins such open space, that is to say:—

In the case of dwellings other than chawls—

Minimum width of open space throughout.	Where height of building above the plinth does not exceed.
2 feet.	22 feet.
3 „	33 „
4 „	44 „
5 „	55 „
6 „	66 „
7 „ where height exceeds	66 „

In the case of chawls—

5 feet.	22 feet.
6 „	33 „
7 „	44 „
8 „	55 „
9 „	66 „
10 „ where height exceeds	66 „

Provided that this bye-law shall not operate to prevent projections, from the face of the building, of other than inhabited rooms if such projections do not reduce the width of the open space to less than 2 feet:

Provided also that such exterior open space shall not be required to be extended as far as the street or open space on which the frontage of the building may abut:

(*b*) Every such interior open space shall have an area equal to not less than one-tenth of the aggregate floor area of all the rooms abutting thereon and shall not be in any direction less than six feet across.

(*c*) Every open space, whether exterior or interior, provided in pursuance of this bye-law shall be, and be kept, free from any erection thereon and open to the sky, and no cornice, roof or weather shade shall over-

hang or project over the said open space so as to reduce the width to less than the minimum provided by these bye-laws.

(*d*) No open drain, except for rain-water, shall be constructed in such open space.

(2) A person who shall make any alteration or addition to such building shall not by such alteration or addition diminish the extent of open space provided in pursuance of this bye-law.

Extract from Rules in Schedule XVII of the Calcutta Municipal Act, III of 1899.

Construction of rules 30 to 36 or 47 to 49.

52. (1) Rules 32 to 36, or rules 47 to 49, as the case may be, shall not be applied in the case of any alteration of, or addition to, a building unless one or more of the following works is, or are, undertaken, namely :—

(*a*) the construction of a roof or an external or party wall;

(*b*) any repairs to the building which involve the reconstruction of a masonry wall and lift, shaft or a chimney after the same has been entirely or in great part demolished;

(*c*) the closing of any door or window in an external wall;

(*d*) the construction of an internal wall or partition;

(*e*) any other alteration of the internal arrangements of a building which affect an alteration of its courtyard or courtyards or its drainage, ventilation, or sanitary arrangements, or which affect its security;

(*f*) the addition of any building, room, out-house, or other structure;

(*g*) the roofing of any space between one or more walls and buildings;

(*h*) the conversion into more than one place for human habitation of a building originally constructed as one such place;

(*j*) the conversion of two or more places of human habitation into a greater number of such places;

(*k*) the alteration of a building for the purpose of effecting a partition amongst joint-owners.

(2) In the case referred to in clause (*g*) of sub-rule (1) the said rules 30 to 36, or rules 47 to 49, as the case may be, shall apply only as regards the structure which is formed by roofing a space, and not as regards adjoining buildings.

TOWN IMPROVEMENT SCHEMES AND BUILDING BYE-LAWS IN THE MADRAS PRESIDENCY.

BY

THE HON'BLE RAO BAHADUR M. RAMACHANDRA RAO, PANTULU GARU.

TOWN-PLANNING and the relief of congestion have already occupied a great deal of attention in the proceedings of this Conference. The principle of betterment as defined in the English Act under which the local authority has a right to a share in the improved value resulting from an improvement scheme, and also the principle of the German Act by which power is conferred on duly constituted authorities to alter the shape of, and otherwise re-arrange plots, so as to render them more suitable for building purposes, have been advocated as methods of sanitary reform and have been accepted by this Conference. It has also been suggested that in congested areas action is desirable on the general lines of the provisions of the English Housing of the Working Classes Act of 1890 and 1909, adapted to the local conditions in India; and that local authorities should be empowered to prepare and carry out improvement schemes in insanitary areas on the general lines laid down in the Town-Planning Act of 1909.

These proposals will, if carried out, I think, be a great step in advance in bettering urban and rural life in India, and, while I believe it is desirable to confer increased powers on local authorities, I do not think they will be of much practical use in the immediate future.

In the first place, the financial resources of the local authorities in this country and in England are entirely different and this fact should always be kept in view. Unless steps are taken to improve the position of local bodies in this respect there is no possibility of their being able to discharge the duties with which local authorities are charged in England under the Housing of the Working Classes Acts. Under the existing conditions, local authorities in India can never finance improvement schemes on the general lines laid down in the English Acts. This will be the greatest obstacle for an effective application of these Acts. A great deal of attention will, therefore, have to be given in maturing the financial proposals involved in the proposed legislation. A thorough examination of national and local finances in India with a view to bring them more into line with the conditions in the West is therefore needed, and till that is done sanitary progress will not go very much beyond the stage of discussion. An improvement in the sanitary condition of Indian towns is not possible till the solution of the problems connected with the housing of the poor is taken in hand on the lines adopted in Western countries. This again depends largely on the financial resources of local authorities.

The second point is that the English principle of betterment, under which contributions from owners of sites and owners of obstructive buildings, towards the costs of an improvement scheme are levied in proportion to the extent to which their lands are bettered, besides being too complicated in its working is not, under existing conditions in India, capable of wide application as a measure of sanitary reform. Except in the Presidency towns and a few of the largest mofussil municipalities, the principle of betterment may be inappropriate and even oppressive in areas inhabited by the poorer classes or intended for them. Where the improvement scheme includes localities which are, or are likely to be, of some commercial importance, or are residences of the well-to-do classes, a contribution based upon the principle of betterment may not be obnoxious; but at present the most urgent attention is necessary in localities inhabited by the poorer classes.

2. An examination of the sanitary schemes hitherto sanctioned and carried out with the aid of Provincial funds will, I believe, generally lend support to the view that the principle of betterment cannot usually be applied to the areas inhabited by the poor. A short account of the steps taken during the last 5 years for the relief of congestion in the municipality of Ellore and of the improvement schemes carried out with provincial funds may therefore be useful in elucidating this point. Before I proceed to give an account of this work, it is perhaps necessary to state that the municipality of Ellore is typical of many other mofussil municipalities in India.

There is the part known as the old town, the relic of the urban life of the pre-British period, with its low ill-ventilated buildings, narrow lanes and overcrowded dwellings; and there are also the later extensions which have come into existence during the last 30 or 40 years. The contrast between the one and the other in all towns in Southern India is apparent. The most important quarter of the old town is the commercial portion, with its bazars, godowns and storehouses. Round this part of the town have grown up small clusters of houses inhabited by the lowest strata of society, the malas and madigas, the leather workers, tanners and sweepers of the Telugu country, the toddy drawers, the shepherds, the milk-men, and various other labouring classes. The irrigation systems of the Godavari and Kistna meet in the vicinity of Ellore, and a large tract of country in the neighbourhood of the town has been brought under wet cultivation. This has resulted in the introduction of a large number of cultivating classes and agricultural labourers from the neighbouring district of Vizagapatam. To these must be added the industrial section of the population engaged in carpet weaving, the jute and rice-mill industries. All these agricultural and working classes occupy the outskirts of the town and live mostly in huts and thatched houses.

3. The first scheme for the sanitary improvement of the town was in regard to the filling up of a portion of the Kistna canal which at one time ran right through the town. The canal was subsequently diverted, but the disused portion formed a big hollow into which all the filth and the storm-water of the neighbourhood collected, forming a breeding-ground for all kinds of diseases. The Public Works Department handed over the disused channel to the Municipal Council which on account of financial difficulties was unable to fill it up for over 15 years. The channel covered an area of $4\frac{1}{2}$ acres and had to be filled in 4 to 5 feet in most places. A scheme at a cost of Rs. 10,000 was accordingly prepared and carried out in 1910. Nearly the whole of the channel has been reclaimed and a great nuisance to the neighbourhood removed. It is impossible to judge of the financial results of the scheme as the site cannot be built upon for a number of years. The scheme was undertaken in the interests of the general sanitation of the town and the owners of neighbouring properties have derived some benefit by the filling up of the channel. But if they were to be called upon for a contribution on the principle of betterment, it would be considered a very iniquitous proceeding.

4. Another most insanitary locality has been acquired at a cost of about Rs. 13,000 odd. This was a collection of thatched huts inhabited by about 750 persons who owned each a small site, the whole site measuring about $3\frac{1}{4}$ acres. It abutted the hospital buildings and was also very low, being 3 feet below the surrounding locality. It was impossible to drain this area and 2 feet of water used to stagnate in the streets. After acquisition the site was filled up at a cost of Rs. 4,000, the total cost of the scheme being Rs. 17,000 odd. This locality was inhabited by the very poorest class of agricultural labourers; and if the principle of betterment and redistribution had been applied to this locality, it would have been impossible to carry out the scheme at all. Even $\frac{4}{20}$th of the amount spent could not have been recovered from the owners. The Sanitary Commissioner considered the work an essential improvement to the town and it could only be carried out by the aid of a Provincial grant.

5. A third scheme was the acquisition of a locality known as Pambalagudem, at a cost of Rs. 6,000. This consisted of about 1 acre and was mostly inhabited by malas who were chiefly agricultural labourers, whose surroundings were most filthy and insanitary. The houses consisted of the poorest classes of palmyra hutting and being in the middle of the better class of buildings they were also a source of constant danger from fire during a greater part of the year. The sanitary authorities suggested the acquisition of this locality in the interests of the general sanitation of the town. The neighbourhood has been improved by this scheme, but on the principle of betterment there is none from whom any portion of the cost can be recovered. The properties that abut this locality on the four sides belong to the Government, the Municipality, and a few private owners. The remainder is a burial-ground. The people who have been benefited by the removal of these huts are the whole population and not only those who abut it. It is impossible to measure the extent to which the neighbourhood has been bettered in order to apply the principle of betterment to this scheme.

6. I shall now refer to another large scheme which is in the course of execution. The total cost of this scheme is Rs. 1,81,000, and its main object is to open up five of the most congested and insanitary areas in the southern portion of the town of Ellore. They were so insanitary that nothing short of wholesale demolition of the houses was possible. The streets were, in many places, so narrow that in cases of fire the houses were death traps. Some of the streets or lanes were only three or four feet broad. The classes inhabiting the houses were of the poorest, and in order to bring the ground surface of these localities to the level of the surrounding roads, the whole area had to be raised by $2\frac{1}{2}$ to 3 feet. A brief description of each of these areas as it existed before the acquisition is given below.

Gazavallivaripeta.—This consists of 170 thatched and tiled houses and the ground-level is lower by 3 feet 6 inches than the adjoining roads. The average site occupied by a house was about 150 sq. yards; the actual extent of some of the house-sites being as small as 75 sq. yards.

There was no outlet for drainage, there being a drinking water tank on one side and pucca houses on a higher level on all the other sides. The cost of the acquisition was Rs. 29,342. After deducting the land required for roads, etc., the remaining land was parcelled out into 53 sites of about 400 sq. yards each, as shown in sketch No. I. The total cost of the scheme, including cost of raising the level and other constructional works, was Rs. 64,494.

Golla and Washerman gudems.—These consisted of 49 thatched and tiled houses occupied by washermen and men of the shepherd castes. The extent covered by the houses was 1·26 ac., 100 sq. yards was the average ground covered by each house, the number of persons living in each house was about 6, and rooms were also found for two or three cattle owned by every family of the shepherds, and also for the soiled clothes and other paraphernalia of the dhobies. The area is situated in a very congested portion of the town and the acquisition of this was mostly in the interests of the sanitation of the town in general, rather than the neighbourhood. The site as now parcelled out after demolition is shown in sketch No. II. The total cost of this scheme, including constructional works, was Rs. 21,230, including Rs. 14,066 as the cost of the compulsory acquisition.

Golegudem.—This area consisted of 90 thatched and tiled houses. The land on which the houses were situated was about 2 to 3 feet lower in level than the adjoining locality. It was inhabited by pariahs, mutrasees and washermen, none of whom could afford to raise the level of the ground. The extent of the site occupied by these 90 houses was about 4 acres, the average size of each house-site being about 200 sq. yards, but in many instances as low as 100 sq. yards. A sketch* shows the site as it existed before action was taken for acquisition, and sketch No. III shows how it is parcelled out. The total cost of this scheme, including constructional works, was Rs. 44,325. This area abuts a Public Works Department canal on the south, vacant village sites on two other sides, there being houses on one side only.

Medaragudem.—This is situated between two main roads and right in the centre of the town and contained 44 thatched and tiled houses, each overcrowded with inmates. The owners were basket-makers and fishermen. The locality was filthy beyond all measure. A sketch * shows the area as it was before acquisition and sketch No. IV shows how it is now dealt with. The site covered by these houses was 5,600 sq. yards and the cost of the acquisition was Rs. 24,616-11-8.

Washerman and Malagudem.—This area is also situated between two main roads of the town and the houses thereon were built in a big pit 3 feet below the level of the roads. This was also in the centre of the town. The improvement of the town required the removal of these houses. It was impossible to get the owners to raise the level of the ground as they lived by daily labour and as the cost, about Rs. 10,000, was beyond their means. The improvement was nevertheless so important to the town as a whole that the only course open was acquisition.

7. I have referred to these schemes in detail in order to show that none of them could be carried out if they were to be financed on the principle of betterment as laid down in the English Housing and Town-planning Acts. In most of these cases either there was no neighbourhood which could be reached for a contribution for betterment, nor would it be possible, satisfactorily, to assess the value of betterment on any principle intelligible to those who would have to pay. Most of the schemes have been undertaken in the interests of the general sanitation of the town and all were much beyond the present financial resources of the Municipal Council.

8. What is, however, most urgently needed in each Province is to take such action as is possible under existing conditions till legislation in regard to Town-planning is undertaken. The most important step in this direction is the acquisition by the local authorities of all lands in the course of development in, or in the vicinity of, all towns showing signs of expansion. This proposal has already obtained the approval of the Government of India (*vide* para. 6 of the letter of the Government of India to the Local Governments No. 1345-1354, *Department of Education*, dated 26th July 1912). The opinion was expressed that where land on the outskirts of a town is mainly agricultural land and can be acquired cheaply, the better policy would be for the local authority to purchase it outright and secure a return by premiums and ground rents as buildings extended, instead of depending on development taxes. Immediate action in this direction is extremely desirable for a variety of reasons. In the first place, the unearned increment will be secured to the local authorities and a highly remunerative investment made owing to the rise of prices of building sites. We have only to look at the history of various town extension schemes started during the last 20 or 30 years in some of the growing towns in Southern India, to realise the enormous rise in the price of house-sites. Ellore, Bezwada,

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*Not reproduced.

Rajahmundry, Coconada, Tenali, and Guntur, have their new suburbs known as Powerpeta, Innispeta, Listerpeta, Fosterpeta, Ramaraopeta, Suryaraopeta, Arundelpeta and Morrispeta, started during the last quarter of a century, and land which was then given away at 2 annas a yard has risen gradually in value and is now worth as much as Rs. 2 a square yard. This difference has gone into the pockets of private individuals. The best course, therefore, for the local authorities in the towns under their control is to acquire the ownership of all agricultural land, in the course of development and fit for building purposes, and to re-sell these gradually after reserving such portion as may be necessary for open spaces, recreation grounds and school houses. Another great advantage of such a step is that the local authorities will have the planning of the new sites in their own hands. At present, individual owners or private committees have this work largely under their own control. In order either to make a profit or to make a scheme pay, sufficient provision for roads and open spaces has not been made and several very serious defects have thereby crept in.

This would be avoided if local authorities laid out these extensions. During the last three years the Government of Madras have, with the financial assistance given by the Government of India, made large sanitary grants for the relief of congestion, and, while this expenditure is bound to bear fruit in due course, the future appears to me to be even more important than the present. An enquiry therefore should be started in each Province for finding the extent to which lands in the vicinity of towns should be secured to local authorities. In the distribution of sanitary grants for the next few years preference may also be given to proposals for the purchase of lands fit for building purposes. In Madras the Government have had under consideration a set of rules for the extension of towns to which the local authorities are directed to conform. These rules have now been finally approved by Government (G. O. No. 1457 M., dated 30th July 1913) (Appendix A). Under the rules now promulgated a scheme for town extension will have to be submitted in a very complete form for sanction. In addition to the proposals for the purchase of lands required for a town extension, the scheme should also make provision for all constructional works including roads, culverts, latrines, wells, and drains. This procedure is, in my opinion, likely in most cases to make the cost of schemes so heavy that it will be very difficult to finance them, and this might, in the case of most local bodies, result in making all efforts at town extension almost impossible. It appears to me that, if local authorities are permitted to make proposals for the acquisition of building land to meet not only present but future needs for the next 20 or 30 years and be allowed to confine proposals for constructional works only to the extent to which they may be immediately necessary, there will be better chance of local authorities undertaking these schemes. Supplementary schemes for additional constructional works may be sanctioned as land is taken up and as the need for them is felt. In the Madras Presidency the Government have, where such a step was necessary, permitted the acquisition of land required for future town extensions, and not merely for housing the people affected by the acquisition of congested areas. I think, therefore, that urgent steps should be first taken for the acquisition of land fit for building purposes, and that the rule that the formation of street and drains must form part of the scheme for laying out the sites, and should ordinarily be put in hand simultaneously with the execution of the scheme instead of being deferred to a future date, will have to be considerably relaxed. All efforts should at first be concentrated on the acquisition by local authorities of lands fit for building purposes.

9. The rules for the levy of ground rents in towns may be referred to in this connection. They are applicable to all town-planning schemes in the Madras Presidency, and are embodied in Standing Orders of the Board of Revenue No. 21 (Appendix B). It will be seen that the principle of betterment is not unknown in the revenue practice of the Madras Presidency, and the increased value in the letting of house-sites in towns is secured thereby to the State. The origin of these rules is to be found in the Orders of the Government of India, printed in G. O. No. 527, dated 6th September 1898. The principle there enunciated is that, except in small country towns where competition is not keen, no part of the full value of lands being the property of the State and utilised for town extensions, should be foregone. The rules framed accordingly provide for the full value being realised, partly in the form of a rent and partly in the form of a price paid, when the land is sold in auction. These rules are in force in all municipalities and cantonments and in all rural towns of an urban character, with a population of not less than 5,000. Collectors are empowered to declare which areas in a district come within the category of towns. As already stated, the value of the site sold is recovered by a ground rent payable annually which, it is laid down, should be slightly below the full competitive rent, the balance of the full value of the site being recovered by a price paid in auction by the purchaser.

The following scale lays down the standard of rates of ground rent :—

(1) Rs. 12 8 0 per acre or 2 annas per cent.

(2) „ 18 12 0 „ „ 3 „ „

(3)	Rs.	25	0	0	per	acre	4	annas	per cent.
(4)	„	37	0	0	„	„	6	„	„
(5)	„	50	0	0	„	„	8	„	„
(6)	„	75	0	0	„	„	12	„	„
(7)	„	100	0	0	„	„	1	rupee	„
(8)	„	200	0	0	„	„	2	rupees	„
(9)	„	300	0	0	„	„	3	„	„
(10)	„	500	0	0	„	„	5	„	„

The ground rent leviable under these rules is liable to revision simultaneously with the re-settlement of the ryatwari assessment of the taluk in which the town is situated. It is, therefore, now revisable once in 30 years. As regards the principles on which the revision of ground rent is to be conducted, there is very little to be gathered from the rules. The only direction given is that the letting value of the site, exclusive of the value of any buildings or superstructure thereon, or other improvements, shall alone be taken into consideration, and the sole judge in this matter is the chief Revenue authority of the district. No rules have been laid down as regards the principle on which the letting value is to be appraised, and there is not even any limit in regard to the enhanced ground rent that may be demanded. The latest orders of the Madras Government on the subject are contained in G. O. No. 1691 Revenue, dated 6th June 1911 (Appendix C). Similar orders in regard to the levy of ground rent are, in all likelihood, in force in the other Provinces. The question, therefore, arises as to whether the levy of ground rents by the State on house-sites in towns, and its periodical revision by the State is desirable, and its bearing on town improvement schemes will have to be considered. If, as stated in the orders above quoted, the full value of a site is to be recovered partly by the payment of a price to be immediately paid, and partly by the payment annually of a fixed ground rent ascertained at a time of sale, I do not see why the price of a site once fixed should be enhanced with the re-settlement of the surrounding agricultural lands. The fact is that, in the framing of these rules, settlement procedure greatly dominated the mind of those who were responsible for them. The adoption of the principles of land settlement to building sites which at one time was agricultural land, appears to me altogether unjustifiable, but it is, however, an unconscious application of the principle of betterment. The increase in the letting value of house-sites is due mainly to the amenities and conveniences provided by the local authorities and at their expense, and there is no reason why the enhanced value in rating should not go to them. The Government should have nothing to do with the rating of letting values of house-sites, and this must be left entirely to local authorities. Those who purchase sites under town-planning schemes have now to look to two authorities, the Municipal and Rural Boards, who revise their rates by a revision once in every 5 years, and the Government who revise their ground rents once in 30 years, and both seek to fix their rates on the *letting value* of the land or site. I think this altogether unnecessary. The system of ground rents should either be abolished or the payments should be limited to a fixed number of years. The present practice has led to a great deal of unnecessary complexity, and the question requires a thorough examination from the point of view of fixity and certainty in the rating on land included in town-planning schemes. The present rules authorise the levy of ground rents even from local authorities, when land is acquired at their cost for the purposes of town improvement schemes, and the sites will have to be sold subject to the payment of a ground rent to Government, which rent is liable to be enhanced in the future. This element of uncertainty is altogether undesirable and is a disturbing factor at present in town-planning schemes and must therefore be removed.

10. The Housing Acts in England impose a very heavy responsibility on the local authorities in regard to the finding of accommodation for the working classes, and for those who are rendered houseless by a town improvement scheme. Local authorities in this country have not undertaken these responsibilities as yet, and in regard to those who are disturbed in consequence of any improvement schemes in the Madras Presidency, it has been the practice to make building ground available to them. Applications for Provincial grants in order to build dwellings for those of the poorer classes who have been deprived of their houses have been hitherto refused. The only local body to make a beginning in this direction is the Madras Corporation, which built about 376 tenement houses for the poor, at an average cost of about Rs. 350; from each of which a rent of Re. 1-8-0 per annum is realised. It was found impossible to reduce the cost of the construction of these dwellings below Rs. 350, and looked at as a business transaction under ordinary conditions, this income is not at all satisfactory. But if a larger income is realised, the classes for whom the tenements are intended would be driven to occupy other insanitary dwellings. In the district municipalities work of this kind has not been undertaken.

The cost of a cheap dwelling-house, according to the design made by the Sanitary Engineer, comes to about Rs. 340, an amount very much above the means of the very poor who require relief, the cost of the katcha hut now occupied by them being only about Rs. 30 or 40. If the relief of congestion in Indian towns is considered one of the essential features of sanitary reform, this cannot be carried out without in some measure undertaking the construction of sanitary dwellings for the very poor. The extreme poverty of the people and the working classes in Indian towns is such that it is impossible for them to build their dwellings on an approved sanitary design. The question was raised in Madras by a motion in the Legislative Council last year, but the Government of Madras refused to do anything which would amount to a recognition of the policy of providing housing accommodation to the poor. It was pointed out that costly as these schemes are for the acquisition of insanitary areas and the demolition of houses thereon, that cost would be nothing compared with the cost of constructing buildings for the accommodation of those who live in insanitary areas. It was also stated that the construction of model-dwellings for the poor was charged to local rates in England, and that the rents charged by municipalities in Western countries are never lower than the rents charged by those who build houses as a matter of commercial undertaking. The higher rents charged by the London County Council were quoted as an illustration and grants for the construction of model-dwellings for the poor, consequent on the relief of congestion, were accordingly refused.

The question, however, remains, whether it is sound policy to spend money on the relief of congestion without at the same time safeguarding the future by looking to the provision of sanitary dwellings for those who are displaced. The present practice of making provision for building-sites is not likely to result in any improvement at all, as the same class of hutting will again be constructed. Is it, therefore, right to treat the construction of dwellings for the poor in municipal areas entirely as a matter of investment from the point of a business-man, or should this be regarded as a measure of sanitation incidental to the relief of congestion ? While I fully recognise the financial difficulties, I believe that under existing conditions, the construction of model sanitary dwellings is essential. If it is not possible to provide dwellings for all those who are displaced, some provision ought to be made in sanitary schemes for the construction of at least a few model-dwellings, so that those that can afford to build may be able to follow good and approved designs.

11. The last point I should like to refer to is one of great practical importance. In a consideration of town-planning, the constitution of Indian society, their habits, and tendencies cannot be ignored, and due provision will have to be made to meet them. Otherwise, town-planning schemes may not be successful. Separate blocks for each class are desired and must be set apart. There is also a tendency of people of each class to cling together as far as possible, and owners of condemned dwellings make a demand to be provided with sites in the vicinity of those belonging to their class. This is another great difficulty. The healthiness of a site cannot, therefore, be the sole consideration, so long as local authorities have no power to compel people to occupy sites selected by them. In the municipality of Ellore 500 sites were properly laid out and made available at a cost of Rs. 28,000 to the malas, madigas, medaras and other poorer classes who were rendered houseless in consequence of relief of congestion. These were specially reserved for them and were excellent in every way and were offered at comparatively cheap rates, but they were not taken up, notwithstanding that their advantages were explained to them at length. Other classes who are in need of house-sites are taking them up and paying much better prices.

APPENDIX A.

NOTIFICATION.—Published in G. O. No. 1457 M., dated 30th July 1913.

Under clause (*n*) of sub-section (1) of section 250 of the Madras District Municipalities Act, 1884, the Governor-in-Council is pleased to issue the following rules for regulating the schemes for the extension of towns and the provision of house accommodation undertaken by Municipal Councils :—

RULES.

No scheme for the extension of a town or for the acquisition of land for the provision of house accommodation shall be undertaken by a Municipal Council, unless the site selected by it for such extension, or acquisition, has been previously approved by the District Medical and Sanitary Officer, or the Sanitary Commissioner, with special reference to the suitability of the soil for building construction, facilities for drainage and water-supply and other matters.

2. The site for an extension should be open to the prevailing winds. It should be elevated above surrounding lands wherever possible and shall have a gravel or sandy subsoil, and when such a site is not available, an open site possessing a sufficient slope either from one end to the other or from the centre outwards should be selected, and the site should not be liable to be flooded. The subsoil should be of as impervious a character as possible, clay being the worst and gravel the best, and the subsoil water-level should not rise during the rains to a height less than 6 feet from the ground-level.

3. Streets shall be marked out on the site, and shall, as far as possible, run in straight lines crossing one another at right angles. The main streets, exclusive of lateral drains, shall be not less than 40′ in width, and the secondary streets not less than 30′. In the case of long streets, cross streets shall be provided at intervals of from 1,000 to 1,500 feet, so as to secure perflation of air and easy exit.

4. All streets shall, unless the Government otherwise direct, be metalled throughout their entire width, from side to side, and not merely the centre of the roadway.

5. Conservancy lanes 10′ in width, exclusive of lateral drains, shall be formed along the backs of houses to enable conservancy carts and scavengers to enter for the purpose of cleansing backyards and for the laying of drainage pipes in the event of the town being provided with underground drainage.

6. Streets shall be provided on both sides with open and impervious U-shaped drains, without joints to carry off storm-water. No such drain shall on any account be rectangular or shall be less than $2\frac{1}{2}' \times 2'$ in main streets, $2' \times 1\frac{1}{2}'$ in secondary streets, and $1\frac{1}{2}' \times 1'$ in conservancy lanes, or shall be constructed so close to the outer limits of houses facing the street as to allow water from the eaves to fall on to the road surface between the side drains. If the drains are constructed of Cuddapah slabs, their joints shall be well cemented ; in other cases their sides shall be plastered with cement sloping to the bottom.

7. The formation of streets and drains must form part of the scheme for laying out the site and should ordinarily be put in hand simultaneously with the execution of the scheme instead of being deferred to a future date.

8. In all cases where the width of the main streets exceeds 50′, Municipal Councils shall, as far as possible, plant and maintain suitable avenue trees on both sides of the street.

9. Suitable places for the construction of public latrines shall be selected and set apart for the purpose.

10. Where there is no pipe water-supply, suitable sites shall be selected for the sinking of public wells.

11. The land acquired for the extension of a town shall be plotted into house-sites, the size of which shall ordinarily be not less than 45′ × 60′. Ordinarily also the sites so laid out shall, unless the Government otherwise direct, be sold in public auction subject to such conditions and penalties for failure to comply with them as may be stated in the sale-deed.

12. Every sale-deed in respect of building-site by a Municipal Council shall contain a condition which shall also be embodied in the notice of sale published by

the Council, requiring the purchaser to complete the construction of the house within a period of one year from the date of purchase and providing that, unless the time is extended by the Municipal Council for good cause shown to the satisfaction of the Council, the purchaser's title to the site shall cease and determine and that the site shall re-vest in the Municipal Council and that the purchaser shall be entitled only to a refund of 90 per cent. of the price originally paid by him to the Municipal Council.

13. No house-sites shall be built upon unless and until the purchaser submits a plan of the building to the Municipal Council, and furnishes the particulars required by section 180 of the Madras District Municipalities Act, 1884, including—

(*a*) a statement showing the dimensions of the building and the levels at which it is intended to lay the foundation and lowest floor; and

(*b*) a statement showing the means of ventilation and drainage and the privies which it is intended to provide.

14. No sub-division of house-sites or construction of more than one house on each site shall be permitted.

15. Houses shall be constructed with frontage facing the streets and shall have an open space of five feet all round.

16. The construction of houses lying back to back shall be strictly prohibited.

17. No house or out-house shall under any circumstances be allowed to be constructed with thatch.

18. The main walls of the house shall not be less than 10′ high. The eaves must not be less than 8′ above the plinth.

19. The provision for ventilation shall comprise suitable windows in the rooms.

20. No house shall be built on a basement of less than 2′ from the ground and such basement shall be of masonry or some rat-proof material.

21. All backyards of houses shall be provided with a gateway so as to give access to municipal officers for the purpose of inspection and to the private scavenging staff.

22. All backyards of houses shall be provided with a suitable impervious bathing platform for the inmates of the house. Each house shall be provided with a latrine to be made to a standard pattern supplied by the municipal office or any other pattern approved by the Municipal Chairman.

23. All sullage water from a house and its backyard shall be drained into the municipal drain in the conservancy lane and not into the drain in front of the house which is provided to carry off storm-water.

24. All cattle yards shall be flagged and properly drained.

25. All houses shall be enclosed by durable compound walls or fences of such description as the Council may prescribe.

26. Except in so far as may be necessary for the excavation of foundations or wells or the levelling or sloping of the ground, no purchaser of a house-site shall remove earth from the site for building or any other purpose so as to leave hollows in it.

27. Rules 13 to 26 *supra* should also be embodied as conditions of sale in the notice of sale published by the Council and in the sale-deed before possession of a site is given. In case of breach of any of these conditions the Council shall call upon the owner of the plot to make the necessary alterations or provision within a period of three months, in default of which the Municipal Council shall be authorised to make them itself and recover the cost from the owner.

28. No relaxation of rules 14 to 26 shall be permitted without the prior approval of the Sanitary Commissioner which will be given only on special grounds.

5. These rules will come into force in all municipalities, other than hill municipalities, on 1st October, 1913.

6. The Tamil, Telugu, Malayalam and Canarese Translators to Government will furnish, as soon as possible, translations of the above notification to the Superintendent, Government Press, Madras, who will print the requisite number of copies in English and the vernaculars and forward to Collectors for publication in the district gazettes.

APPENDIX B.

Board Standing Order No. 21.

Section (ii).—In Towns.

8. Definition of "Town."—No place shall be classed as a town for the purposes of this section unless—

(*a*) a Municipal or Cantonment Act is in force therein, or

(*b*) (i) the place has a population of not less than 5,000 inhabitants residing in houses more or less contiguous, not in scattered collection as hamlets, and

(ii) has a distinctly urban character such as that of a market town.

9. *Publication of list of towns.*—The Collector shall publish in the district gazette a list of towns as classed under paragraph 8, and may, from time to time, alter the list by notification in the district gazette.

10. General provisions in regard to town-sites—

(i) *Scale of grant for building purposes.*—In towns, portions of house-sites at the disposal of Government may be granted for building purposes, in accordance with a scale fixed, or to be fixed, by Collectors with reference to the requirements of their district or of particular towns or quarters of a town, and subject to the conditions laid down in paragraphs 11 to 17 below. The scale may be altered by Collectors from time to time, according to their discretion, but every such alteration should be previously published in the district gazette.

(ii) *Register of land suitable for building purposes.*—A register should be maintained by the village officers of each town, showing the situation and extent of all land at the disposal of Government and suitable for building purposes. This register, the form of which should be determined by the Collector for each district or local area, together with the supplements A, B and C, described and illustrated in Appendix XVII, should be bound up with the register of applications prescribed in Appendix XVI.

(iii) The disposal of vacant Government lands within port-limits for the erection of houses should be subject to the conditions laid down in paragraph 2 (iv) of Standing Order No. 15. The erection of houses on Government lands within port-limits is, however, *primâ facie* objectionable, and if there is reason to think that the port-limits are unnecessarily wide, the Port Officer should be moved to revise them.

(iv) *Town-sites not to be appropriated without previous permission.*—Collectors will assert the prerogative of Government by making it known that town-sites at the disposal of Government cannot be appropriated without permission previously obtained.

(v) *Consequence of such appropriation.*—If any portion of such town-site is appropriated without permission and the Divisional officer considers that the occupation is objectionable or that the occupancy-right should be sold by auction, the appropriator will at once be warned to vacate within a reasonable time, not exceeding one month, to be specified in the notice. If the notice is not complied with, the provisions of Act III of 1905 should be applied in accordance with the instructions contained in Standing Order No. 26.

(vi) *Responsibility of village officers.*—Village officers will be held responsible for preventing and reporting encroachments.

(vii) *Cultivation of town-site.*—The cultivation of vegetables, tobacco, etc., within the recognized limits of backyard included in a house-site need not be interfered with. But the cultivation of any portion of house-site in towns which is not a backyard is an undoubted abuse, and should be treated as unauthorised occupation under Act III of 1905 in accordance with the instructions contained in Standing Order No. 26, unless action is barred or appears inadvisable owing to long possession. No *patta* should be granted for such cultivation.

(viii) *Extension of town-site.*—When the existing town-site does not suffice for the needs of the residents, Collectors may add thereto any adjacent land at the disposal of Government and may for the same purpose, in districts where such a course is permissible, acquire under the Land Acquisition Act, land not at the disposal of Government.

(ix) *Sanitary requirements.*—In granting town-sites for building purposes Divisional officers will bear in mind, and as far as possible give effect to, the general orders in Standing Order No. 99, which are meant to ensure width and straightness of streets, to guard against overcrowding and also to make suitable provision for drainage.

11. *Procedure to be observed in the disposal of applications.*—The following procedure shall be observed in dealing with applications for house-sites in towns :—

(i) *Contents.*—Applications for house-site shall be made in writing and shall clearly specify the land required, and the purpose for which it is wanted, *i.e.*, whether for constructing a thatched, tiled or terraced building, a place of worship or for erecting cattle-shed, etc.

(ii) *Officer to whom presented.*—The application may be presented in the first instance to village officers, who will then forward it to the Tahsildar with a report in duplicate in the form given in Appendix XVI, omitting columns 14 and 16. Applications made to the Tahsildar

direct should be referred to the village officers for a report in the same form.

(iii) *Registry.*—Village officers shall register applications in order of date in a bound book, the pages of which should be consecutively numbered, and similar registers shall be maintained in Tahsildars' offices.

(iv) *Report.*—A copy of the village officer's report should be sent by the Tahsildar to the Municipal Council or Union Panchayat having jurisdiction over the town, and the objections of those bodies, if any are raised by them, should be considered by the Tahsildar.

(v) *Disposal.*—If on a perusal of the village officer's report and the remarks of the Municipal Council or Union Panchayat and after such enquiry as may be necessary, the Tahsildar considers the disposal of the site under this paragraph to be unobjectionable, he should inform the applicant accordingly. In the case of towns that have been or are likely to be surveyed, a deposit of Rs. 5 for each lot shall be required from the applicant at the same time to defray the cost of demarcation and survey. This deposit shall be paid within ten days after the Tahsildar's intimation; failing payment, the application will be considered cancelled. On receipt of the deposit above referred to, the Tahsildar shall cause the land to be demarcated and surveyed as soon as possible. On completion of such work the Tahsildar should cause a notification in the form given in Appendix XX to be published in the town by beat of drum and also to be posted up in some conspicuous place as well as on the land applied for.

(vi) *Auction sale.*—The auction should be held by the Tahsildar or by some officer duly authorized by him on the date fixed in the notification or on any subsequent date to which the sale may be adjourned for good reason, of which fact due public notice should be given, and the lot should be knocked down to the highest bidder. In cases where lands have been demarcated and surveyed at the expense of applicants, an upset price shall be fixed which shall be the cost of such demarcation and survey.

(vii) *Deposit.*—The purchaser of the lot should be required to deposit at once 15 per cent. of the amount of his bid and to sign an agreement consenting to forego the deposit in case the remainder of the purchase money is not paid within thirty days after sale. If the original applicant be the purchaser, he shall receive credit for the deposit paid by him under clause (v) *supra;* otherwise the amount shall be repaid to him at once from the sale proceeds.

(viii) *Confirmation of sale.*—The result of the sale shall be submitted immediately to the Divisional officer, who may, subject to the provisions of clause (x), either confirm the sale or cancel it in the exercise of his discretion or for any other good reason. Thus, he may refuse to confirm grants for thatched houses in places where there is risk of fire, or where such houses would be out of keeping with neighbouring buildings. He may also exercise his discretion in regard to confirming grants made for building places of worship, schools and similar institutions.

(ix) *Appeal.*—An appeal to the Collector will be allowed against an order passed by the Divisional officer under clause (viii). There shall be no second appeal.

(x) *Government sanction when required.*—Sales of the occupancy right in land, the value of which exceeds Rs. 50,000, shall be subject to the confirmation of the Board of Revenue; and if the value exceeds Rs. 10,000, to the confirmation of the Government.

NOTE.—In the disposal of plots within the municipal limits of Ootacamund, Coonoor and Kodaikanal, the previous sanction of Government to the sale of the sites shall be obtained.

12. *Rate of ground rent.*—The Collector should determine the rate of ground rent on each plot dealt with under these rules before it is put up to auction. The rates fixed should be slightly less than the full competitive rent, the balance of the full value of the site being recovered in the auction price. Ordinarily the Collector should adopt such one of the rates given in Appendix XXI as most nearly fulfils the condition. If no bids are made at the auction at the rate so fixed, it should be reduced unless the absence of bids is due to combination or want of publicity and the like causes. The minimum rate of ground rent should be Rs. 12-8-0 per acre.

13. *Periodical revision of ground rent.*—The ground rent so fixed and payable shall be liable to periodical revision simultaneously with the re-settlement of the ryotwar assessment of the taluk in which the town is situate. In making such revision the letting value of site, exclusive of the value of any buildings or

superstructures thereon, or other improvements, shall alone be taken into consideration.

14. *Reduction of ground rent in special cases.*—The Collector may at his discretion lower the rate of ground rent below the minimum fixed in paragraph 12 in special localities, *e.g.*, in parts of towns inhabited by the poorer classes or where the cost of building houses is unusually high ; when the concession is made on account of the applicant's poverty, care should be taken to word the *patta* in such a manner as to prevent the benefit of concession being claimed by assignees, such as sowcars, who were not intended to benefit by it. The Collector may also dispense with the sale of occupancy right by auction whenever he considers this course to be advisable in the following circumstances :—

(1) Where an application is made for a mere extension of an existing house-site and not for a full-sized plot according to the scale prescribed under paragraph 10 ; in this case the Collector may levy the full market value of the site from the applicant, or

(2) where the applicant is too poor to purchase the site at auction : in this case the site may be assigned subject to the payment of ground rent either at the ordinary rate or at the special rate referred to in the first part of this paragraph.

(3) If *bonâ fide* ryots or agricultural labourers apply for house-sites on the outskirts of towns where large areas of vacant land exist, such cases should be reported for the orders of the Board which may, if the Collector so recommends, grant the sites to the applicants on the appropriate ground rent, but free of any initial payment.

15. Procedure subsequent to the grant of house-site—

(i) *Register of grants.*—A register in the form given in Appendix XVIII shall be maintained for all house-sites granted in towns.

(ii) *Form of patta.*—A *patta* in the form given in Appendix XXII shall be issued for all sites assigned under this section, but Divisional officers may impose any additional conditions regarding the provision of means of drainage with reference to Standing Order No. 99 or any other sanitary or administrative requirement. The grantee may also be required to execute an agreement binding himself to fulfil such conditions on pain of forfeiting the grant.

(iii) *Right of re-entry.*—The right of re-entry, whether under the provisions of the *patta* or under those of any subsidiary agreement, should be enforced only under the orders of the Divisional officer. Before ordering such re-entry the Divisional officer may, as a matter of grace, give notice (*a*) to the grantee and (*b*) in the District Gazette.

(iv) *Extension of period prescribed for building.*—The Divisional officer may also, as a matter of grace and when special cause has been shown for such a concession, extend the period prescribed in condition (3) of the *patta*. Ordinarily the period should be made to commence so as to give the *pattadar* a clear period of six or twelve months, as the case may be, from the date of decision of any appeal that may be preferred against the Divisional officer's order confirming the sale. In the case of sites in Kodaikanal, however, the period allowed for the construction of a tiled or terraced building shall be two years.

16. *House-site in Cantonments.*—In military cantonments, the ground rent of land should be levied and carried to account by the local Revenue officer. The terms of all old grants should be respected, ground rent being levied at the rates therein mentioned. For land in excess of the extent mentioned in the grant or held without grant, the Collector may, at his discretion, require the occupant to pay the appropriate ground rent, if such land is used as house-site ; otherwise the Collector will deal with the case in accordance with clauses (iv), (v) and (vii) of paragraph 10, *supra.*

17. *Sites within fortifications.*—Grounds within fortifications at out-stations on which buildings are erected by private individuals are chargeable with ground rent or assessment, which shall be collected and carried to account by the Revenue officer of the District in which the fortification is situated.

APPENDIX C.

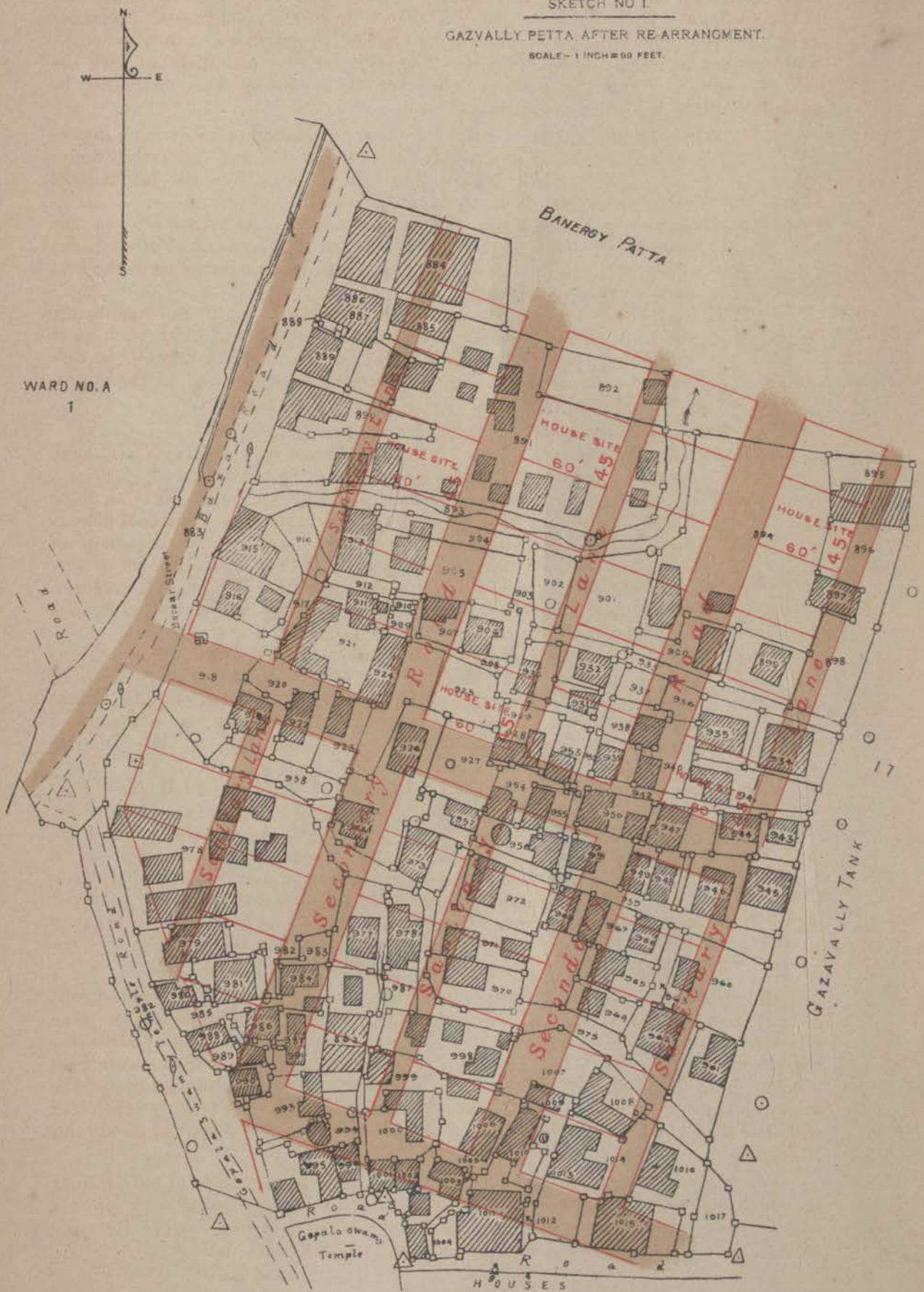
GOVERNMENT ORDER NO. 1691.—*Revenue, dated 6th June* 1911.

The following principles which will generally be applied in future in regard to the levy of ground rent on lands acquired by local bodies generally and especially

SKETCH NO 1.

GAZVALLY PETTA AFTER RE-ARRANGMENT.

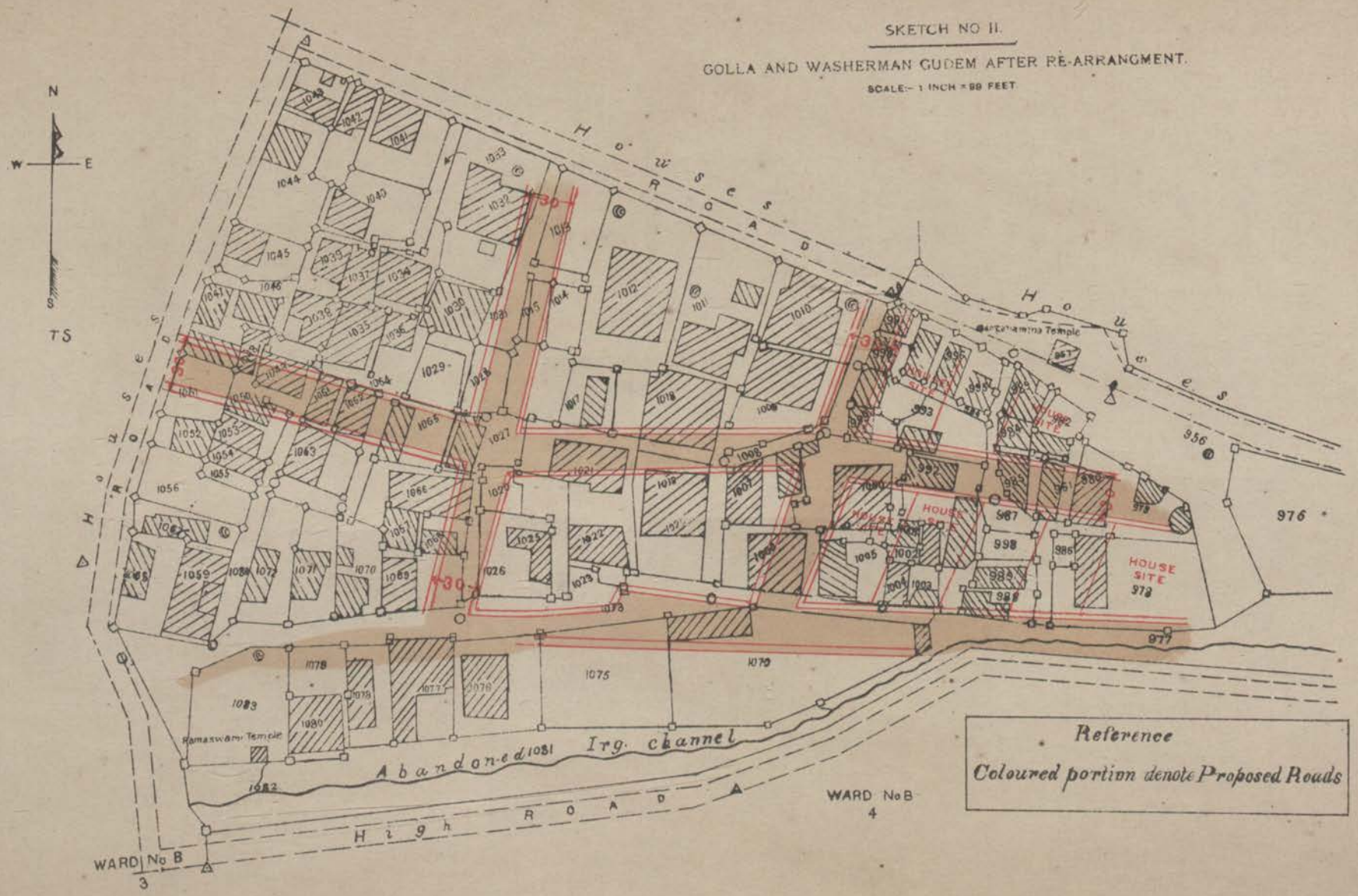
SCALE- 1 INCH = 99 FEET.


N.
W.
E.
WARD NO. A
1
BANERGY PATTA
HOUSE SITE
60'
45'
Secondary Road
Secondary Lane
Secondary Lane
Secondary Lane

SKETCH NO II.

GOLLA AND WASHERMAN GUDEM AFTER RE-ARRANGMENT.

SCALE:- 1 INCH = 88 FEET

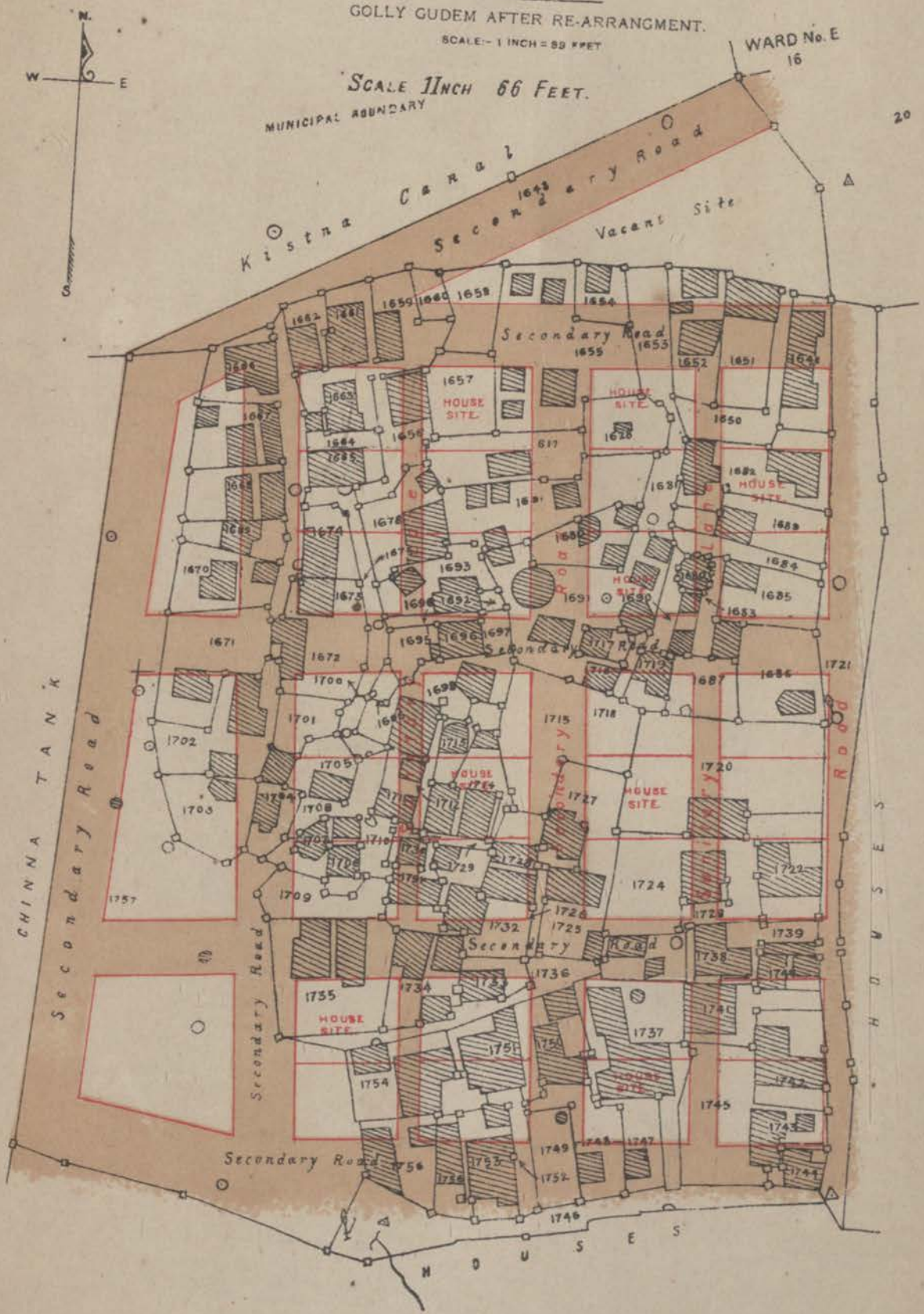


SKETCH NO III.

GOLLY GUDEM AFTER RE-ARRANGMENT.

SCALE:- 1 INCH = 33 FEET

SCALE 1INCH 66 FEET.



SKETCH NO IV.

MADARA GUDEM AFTER RE-ARRANGMENT.

SCALE:- 1 INCH = 99 FEET.

in regard to lands acquired for the extension or provision of house-sites. Such lands thus acquired generally fall under one of the following classes :—

(1) Lands at the disposal of Government which are made over to the local body ;

(2) Lands which are acquired by Government at the cost of the Government and made over to the local body ;

(3) Lands which are acquired by Government at the cost of the local body and made over to it.

(4) Lands which are acquired by the local body by private purchase.

As regards lands falling under classes (1) and (2), the Government consider that full ground rent should as a rule be charged. In cases in which the local body does not derive any income from the land or derives an income which is less than the expenditure annually incurred, the levy of ground rent may be waived at the discretion of Government in accordance with the rules laid down in section (ii) of Board Standing Order No. 24. As regards classes 3 and 4, the lands will ordinarily remain subject to the same ground rent or assessment as was levied on them before acquisition. If the land was held free of assessment or ground rent previous to acquisition the immunity will ordinarily be allowed to continue, but it will be distinctly understood that such immunity is entirely a matter of grace and that it will be open to Government at any time to withdraw it and to impose ground rent should sufficient reasons appear. In all cases the rate of assessment or ground rent, if any, will be liable to periodical revision at re-settlements.

SANITARY IMPROVEMENT IN URBAN AREAS.

BY

LALA JAI LAL, B.A.,

Municipal Commissioner, Simla.

Sanitation of urban and rural areas is one of the most difficult but at the same time one of the most important problems occupying the attention of the Government and others interested in the welfare of the millions of the inhabitants of this country. On the correct solution of this problem depends the physical and mental well-being and progress of India.

In this paper I propose to deal with the question of sanitary improvement of urban areas, leaving the rural areas for discussion on another occasion. I do not pretend to deal with the subject systematically or extensively, but have attempted to put down on paper in broad outlines some stray ideas as they came to me.

The sanitary administration of the principal and important towns has been entrusted to local Municipal bodies whose powers are defined by special acts of the Legislature. One important function of these bodies is to control the construction of new buildings and to see that the existing buildings do not become offensive or dangerous to the public either through disrepair or want of proper sanitary arrangements. It is this function that I propose to make the subject of special discussion in this paper.

It happens, and not very seldom, that in considering applications for permission to construct new buildings the Municipal authorities fail to take into consideration the effect of the proposed building on the future of the area in which the building is proposed to be constructed. They fail to consider that in course of time other buildings are likely to spring up in the locality and that this will necessitate properly laid out roads and streets, drains, sewers, etc. The result is that when, after the lapse of some time, these improvements are taken in hand a very great difficulty has to be met. Heavy compensations have to be paid to set back or acquire existing buildings, and great annoyance and inconvenience is caused to all concerned. I think it would be a very prudent policy for all Municipal bodies to frame their programmes with due regard to the probable future expansion of areas under their administration and to have a regular scheme planned out for future roads, etc. A plan and reference book on the subject if kept in the office would be found very useful. All suggestions made and approved by the Municipal bodies should be entered in these documents and should be referred to when dealing with all building applications. Generally there is not much continuity in the personnel of these local bodies and such documents would lead to a continuity in their policy.

The most difficult work of the Municipal bodies however is the improvement of the existing buildings and areas built upon. Several methods are in use to attain this object, *e.g.*

(*a*) compelling owners to pull down or repair ruinous buildings ;
(*b*) closing of insanitary buildings till made sanitary ;
(*c*) acquisition and demolition of buildings in congested areas ;
(*d*) reclamation of entire areas on which insanitary or ruinous buildings stand.

(*a*) and (*b*).

The powers of the Municipal bodies regarding (*a*) and (*b*) are regulated by the special acts creating such bodies. I am unable at present to discuss the special provisions in the acts in force in other provinces. In the Punjab, Sections 113, 114 and 116 of the Punjab Government Act III of 1911 deal with the powers of the Committees. But I venture to think that the powers given by these sections have been found to be inadequate to deal with the case of buildings which are so insanitary, or in such a ruinous condition that nothing short of their entire demolition and reconstruction would remedy the defects. It has been held by the Chief Court of the Punjab that a Committee is bound to give to the owner of a ruinous building the option of either removing it or repairing it, and that the repairs required by the Committee should be specified in the notice. Thus the whole

responsibility is thrown on the Committee and it has been considered that a notice requiring an owner to either remove or reconstruct a ruinous building would be illegal.

In the case of insanitary buildings the hands of Committees are a little stronger as they can prohibit the building to be used for human habitation till the same is made sanitary. But the Municipal bodies are incapable of taking any action regarding buildings occupied for purposes other than human habitation. No powers are given to the Committees to deal with buildings which are a source of danger to the health and sanitation of neighbouring buildings. Perhaps this is a point on which opinions might differ as to the advisability of conferring such powers on the Municipal bodies, as the exercise of such powers benefits the neighbouring properties at the cost of another. I consider that such powers are essential for the proper exercise of their functions by the Municipal bodies and that in such cases power should also be given to the Municipal bodies to compel the persons who benefit by such actions to contribute towards the loss sustained by the injured person and thus share the expense incurred by Municipal bodies. Sanitary considerations should ordinarily override all others and individual interests must give way before public health and benefit.

(*c*). The acquisition and demolition of buildings in congested areas is a question which is not free from difficulties. The Municipal Acts generally do not deal with this question. Action can only be taken under the Land Acquisition Act I of 1894. This Act deals with the law on the question of acquisition of land for public purposes. The "public purposes" for which buildings are acquired to be demolished includes "relieving of congestion." It is a question to what extent relieving of congestion is a "public purpose" according to the Land Acquisition Act. There are, however, several other considerations which deserve attention in this connection. In my opinion it is a great mistake to start on a campaign of acquisition and demolition of buildings in congested areas without first providing for the suitable accommodation of the persons occupying such buildings; if this is not done, the very act intended for relieving congestion defeats its own purpose. The persons occupying such buildings have naturally to find accommodation elsewhere, and unless the number of houses available for occupation is increased, these people necessarily go and occupy existing houses, thus increasing the number of residents therein and consequently causing further overcrowding. Thus in trying to relieve congestion in one set of houses, we increase it in others unless new and suitable buildings are first constructed to take the place of the houses to be acquired. I have mentioned this defect as I have come across concrete examples. The Simla Improvement Committee of 1907 have recommended the acquisition of several properties in the bazaars in order to relieve congestion, and between the years 1904 and 1910 several houses or sites of houses have been acquired by the Simla Municipal Committee. There were buildings on such sites which were destroyed either by fire or landslips. These houses accommodated almost 200 families, say about 1,000 persons. No provision was made then, or is proposed to be made now, for the accommodation of the persons who occupied the houses already acquired or who occupy the houses to be acquired, in spite of the fact that the population of Simla is increasing daily. These 1,000 persons have taken quarters in the other houses and have made them overpopulated, and unless precautions are taken beforehand the same result is likely to accrue from future acquisitions.

There are many who question the wisdom of acquiring and demolishing houses unless the site on which they stand is made part of a public street or alley. If the site is left as an open piece of ground between other houses it comes to be used as a dumping ground for the filth and rubbish of the neighbouring houses and is thus a source of nuisance. I think the acquisitions to relieve congestion should be so arranged that the sites of the acquired buildings may become the links or continuations of existing roads or streets.

Again, the demolition of buildings for the purpose of relieving congestion naturally increases the value, comfort and sanitation of the adjoining buildings. The Municipal bodies have to pay for such demolished buildings, while the neighbours benefit vastly by these acts of the bodies. There is no reason why a limited number of persons should benefit at the expense of the large number of tax-payers. I think such neighbouring owners should be made to pay their share of the expenditure incurred in the improvement in proportion to the benefit derived from it. There is no law at present in India under which this could be done. I understand there is such a law in England.

Then in the majority of cases the buildings selected for acquisition and demolition for purposes of relieving congestion are such as are either in a ruinous condition or are so old as to be almost unfit for human habitation. If such buildings are to be acquired under the Land Acquisition Act, the owner has to be paid 15% on the market value of such buildings in addition to their full market value, irrespective of the condition in which they are, and without regard to any other possible benefits that the owner may obtain from the demolition of the buildings. This to

my mind is a very hard and arbitrary rule to the detriment of the Municipal bodies. The determination of the market value of such buildings is also a very complicated affair. In some places so many years' rental has become, either by legisation or by authority of judicial tribunals, the determining factor of market value. No regard in such cases is taken of the condition in which a particular building may be or of the locality in which it may be situated or the purpose for which it is being used. Now all these factors are important ones to be considered by a purchaser when buying a building, but presumably the Land Acquisition Officer may not do so. I have mentioned this point as the Chief Court of the Punjab has, in an important case, held that the values of the buildings in Simla are 14 times the annual rentals. Land Acquisition Officers in Simla have considered themselves bound by this dictum of the Chief Court and have been giving 14 years' rentals for properties acquired subsequent to this decision of the Chief Court, while in private sales some properties have fetched more than 20 years' rentals, while others have fetched only 5 years' purchase. The hardship of this hard and fast rule is apparent and, in any case, the judicial officers dealing with Land Acquisition cases find it hard to determine the market value of "lands" for want of definite evidence of the past sales and opinions of witnesses on the values of properties are not considered acceptable. Thus it will be seen that the existing law so far as it relates to the matter under discussion is both inadequate and indefinite.

(*d*) Reclamation of entire insanitary areas to relieve congestion has met with the same difficulties as the acquisition and demolition of buildings and almost all the remarks made above regarding the latter apply to the former. An additional difficulty which is usually experienced in the reclamation of insanitary areas is the paucity of funds available with the Municipal bodies for such purposes. The result is that such bodies have to content themselves with gradual reclamation or to leave matters as they are. I think powers should be given to the Municipal bodies to issue debentures or to form improvement trusts for such purposes without the necessity of asking for special legislation on each occasion.

Imperial and local Governments might treat the Municipal bodies very liberally by granting loans on easy terms, or by giving free grants of money for the purpose of reclamation and improvement of insanitary areas. I wish to lay special emphasis on the necessity for Government rendering all possible help to the Municipal bodies in this respect. The abeyance of schemes of reclamation or their very gradual enforcement is very often injurious both to the Municipal bodies and the private individuals concerned. To illustrate by a concrete example. In Simla there is a fairly extensive area below the Cart Road near the Bazaar. This area is in a very filthy condition, the houses thereon are generally dirty and very old ramshackle buildings. About four years ago I submitted to the Municipal Committee a scheme suggesting the reclamation of the whole of this area. I pointed out that the Committee was likely to make money by sale of sites and would relieve congestion in the Bazaars and that the reclamation was in every way advantageous to the public. The scheme was approved by everybody concerned, but no action could be taken for want of funds. No new buildings are allowed in this area owing to its being in an insanitary condition, thus causing hardship to the owners of the lands and there are no prospects of the area being improved in the near future.

The hardships mentioned above in connection with the acquisition of buildings to relieve congestion are also keenly felt by the Committee. From the beginning of this year gradual reclamation of this area has been taken in hand, but this also is in the long run injurious to the Committee because the improvement of one part increases the value of the neighbouring part, with the result that the compensation to be paid for future instalments of reclamation is likely to increase proportionately every year.

It is a question whether the Land Acquisition Act confers powers to acquire areas for the purpose of reclamation of insanitary areas. "Public purpose" is defined in section 3, clause (*f*) of the Land Acquisition Act. The definition is characteristically vague and useless. One might very well infer from this definition that the provision of building sites in towns is not a "public purpose."

I have so far dealt with the destructive part of the reclamation schemes. After an area has been acquired and cleared the first business of the Municipal body should be to lay it out in a systematic method providing room for roads, bazaars, streets, drains, etc. In order to bring in the best profit, building sites should be prepared where necessary. Afterwards the sites should be sold to the best advantage. It would be a very great improvement if power were conferred on the Municipal body to insist on houses being constructed on such sites in a uniform manner so far as structure, material, appearance, etc., are concerned. Construction of model buildings by these bodies might with advantage be taken in hand. Under the present law Municipal bodies are bound to sanction the construction of buildings if they are strong structurally and proper provision is made to make them suitable for human habitation; any other consideration such as those mentioned above is beyond

the competence of the Municipal bodies. Fresh legislation would be necessary if such powers are to be conferred on the Municipal bodies.

Action is contemplated in Simla on these lines in the case of the reclamation of the mohalla alluded to above. But this will have to be done purely by persuasion and not by compulsion. Persuasion is not expected necessarily to succeed in every case. It is proposed to build a model dwelling house in this locality on a site which has already been cleared. Plans of model dwelling houses which the Committee would like to see constructed in this locality have been prepared and every facility will be given by advice and otherwise to the proprietors or purchasers of sites to have plans prepared in conformity with those of the Committee. The plans are such as to enable people to build houses of uniform pattern so as to accommodate different numbers of families according to the size of the sites. The whole work is being done under the direct supervision of Captain R. A. Needham, I.M.S., Health Officer of Simla, from whom the constructive portion of this scheme has mainly originated. But for the legal difficulties related above the work would have by this time been far advanced and want of funds is unfortunately presenting a great impediment to its completion at an early date.

There is another direction in which Municipal bodies might do useful work in improving existing streets and lanes. When deciding applications for reconstruction of an existing building, power is given by the municipal acts to order the putting back of the building if necessary so as to bring it in line with the adjoining buildings, but the Committee is bound to allow compensation for the loss suffered by the applicant by such putting back. These powers are very seldom exercised by the Municipal bodies. The procedure for determining compensation is by regular civil suit and this is notoriously an expensive and lengthy procedure. If a Municipal body ever thinks of ordering the demolition of projecting parts of an existing building so as to get an uniform width of road or street, resource has to be had to the provisions of the Land Acquisition Act which again is not such an easy and simple affair.

It is very necessary in all such cases that disputes should be settled expeditiously and in a simple manner. The best procedure would be arbitration under the supervision of courts or without such supervision, if so desired. The arbitrators should be selected by all parties concerned in equal number. This would simplify the procedure, the hard and fast rules of evidence would not be binding and all parties interested would have the satisfaction of getting decisions based on justice and common sense and would be saved the trouble of going to courts of appeal. The procedure in fact would be somewhat analogous to "trial by juries." As the disputes would relate principally to properties situated in big and important towns reliable and competent arbitrators would not be difficult to find.

I would suggest that a special law be enacted dealing with all the points I have mentioned above. The power of the Municipal bodies should be enlarged on the matters discussed above and the rules relating to award of compensation for the acquisition, etc., for the particular purposes enumerated, be modified, and provision made for the contribution by owners of properties who benefit directly by such acquisition. All disputes should be made referable to Committees of arbitration and the decisions of such Committees should be made final.

I do not for a moment mean that the proposed enactment should be of universal application to all Municipal bodies. It should be made applicable only to selected and big Municipalities and the scope of its operation should be limited strictly to the improvement or reclamation of existing insanitary and overcrowded areas or to the laying out of new towns or parts of such towns.

EXTENSION OF BANGALORE CITY.

BY

MR. KRISHNA IYENGAR, B.A., L.C.L.,

Deputy Chief Engineer, Mysore Public Works Department.

The origin of the extensions.—Activities in the direction of large improvements to, and extensions of, old towns in the Province were first brought into play in connection with the adornment of the capital of the State, *viz.*, the town of Mysore. Here an extension known after the name of His Highness the late Chamarajendra Wodayar Bahadur, G.C.S.I., as the Chamarajapura extension, was first laid out in the year 1892, by the then Sanitary Engineer, the late Mr. Standish Lee. The beneficial results obtained therefrom induced the authorities to make similar attempt in Bangalore where it was more urgently needed on account of excessive overcrowding in the old city. Soon after, an extension was designed and laid out to the west of the Bangalore Fort, called the Chamarajendrapet extension, also after the name of the same Maharaja (*vide* General Survey, Plan No. 1).

2. *Further developments.*—The old city with a compact area of 666 acres contained, previous to the advent of plague, a population of more than 70,000. Even allowing a limiting density of 60 souls per net acre, the population that might be allowed to reside in this area without the evils of overcrowding was only 40,000. It appeared then that there were at least 30,000 people more in the city than there ought to have been, for whom accommodation had to be found elsewhere. The evils of overcrowding at once became apparent when plague first broke out in 1898 and took a firm hold of the city. It was then that further extensions to the north and the south of the old city were undertaken at a considerable cost to Government. People also recognising the value of building detached houses in open areas, readily responded to the call of Government and numerous houses built on sanitary lines sprang up in the course of a few years. Recently, a fourth extension connecting those on the west and the south has also been opened out.

3. Before proceeding to note the details of these extensions, it is necessary to offer a few brief remarks on the geology, topography and climate of the place, as these in no small measure affect the health and sanitation of these extensions and give them the distinctive features they possess.

4. *Geology.*—The portion of the ground comprised within the present limits of Bangalore City and its sister suburb, the Civil and Military station, forms a miniature plateau. The rocks prevalent in the area consist mainly of a gneissic complex intruded by long narrow bands of fine grained granitic masses. The latter weather and give rise to detached boulders often delicately poised one over the other. Runs of pigmatite often bearing magnetite are also noticed into the fundamental gneissic complex. These geological facts are here mentioned to indicate roughly what soils may be expected to result from the weathering agencies and denudation of such rocks and how these soils would behave as regards the sub-soil drainage, absorption and retention of water and facilities for water-supply and surface drainage, matters determining in no small measure the sanitary conditions of a locality for human habitation.

5. The very soft nature of some of the caught-up masses or xenolites enclosed by the harder gneissic or granitic rock has given rise to formations of hollows or depressions. These depressions are subsequently filled up by detritus from higher levels. The laterite soil appears to owe its origin to the iron contained in the gneiss and to a few other factors. Red soil accumulates at the lower levels surrounding the plateau. White clay often results from the decomposition of felspar in the gneiss and militates against free underground circulation of water; whereas accumulation of quartz sand with varying quantities of clayey matter forms the various gravels which allow free percolation of water.

6. *Topography.*—The surface of the plateau has been furrowed into and diversified with numerous valleys and ridges. The several valley lines and intervening

ridges are shown in the accompanying tracing from the topographical maps (*vide* plan No. 2). The centre of the plateau may be considered to be somewhere near the Trigonometrical station, marked 3, 118, to the north of the city on the left of the Trunk Road from Bangalore to Bellary. Numerous valleys radiate from this point. The ridges undulate steeply on all sides and are composed of red soil and gravel of various thickness ranging from 6″ to several feet overlying deep decomposed gneissic rock. The surface drainage is consequently perfect, while the porous nature of rock below eminently helps the sub-soil drainage. On ridges with comparatively large flat tops like the ridge on which the northern or Malleswaram extension is situated, we have to go down 30 to 40 feet and sometimes more to tap springs. No better place could be found for the location of healthy human habitations.

7. The flanks of the valleys are composed of the detritus from the ridges. Here the soil is sticky and retentive and the level of sub-soil water is also high. These valleys unless perfectly drained are not so suitable for residential purposes as the ridges. But the necessities of water-supply forced the old inhabitants to cluster round the sides of these valleys where water could be found at no great depth. The art of getting a supply of water by pumping or from sources at distant elevated points was unknown. Subsequent growth was determined by considerations of safety, society and business. Elevated plots of ground were consecrated to temples or tombs, public offices or playgrounds. This proclivity to perch on the sides of *nallas* or rivers, while it enabled the inhabitants to have facilities for water, compelled them to reside in localities where the soil was generally retentive and the level of sub-soil water high, factors inimical to health and conducive to the development of zymotic diseases which were gradually intensified by defective arrangements for sewage disposal, want of ventilation in most of the houses and overcrowding by the rapid increase of population. Want of localities fit for residential purposes and commanding water-supply and other necessary conveniences, deterred people from resorting to the ridges.

8. It is only after the introduction in 1896 of a modern system of water-supply at a cost of about 20 lakhs that extensions of the city on high-lying ridges became popular with the inhabitants. The evils brought about by the advent of plague in 1898, forced the people to move out to more open areas. And assured as they were of a liberal water-supply and encouraged by a generous Government, they cheerfully took up sites in the extensions and built up-to-date houses on a scale probably rarely met with in other parts of India.

9. *Climate.*—The climate of Bangalore, as of other places included in the table-land of the Deccan, is alternately influenced by the two monsoons. The city receives the larger portion of its annual rainfall from the south-west monsoon when humid winds keep on blowing for four months, June to October. In the north-east monsoon also, there is some rain but the climate generally is what the "unkindly north-easter" gives rise to, dry biting cold, in some months. These determine the favourableness or otherwise of the so-called aspect of the houses preferred or avoided by the people. South-west and north-east are avoided on account of the inclemencies of weather. Generally direct east and west, north and south are preferred, while owing to the inconvenience of both the morning and the evening sun, the latter is considered the best. These facts have in a way determined the lay-out of the extensions, to be noticed further on. Attempts to suit the extensions to the configuration of the ground have not been possible for this reason.

2.—The Extensions.

10. The first one thought of in this connection as already noted is the Chamarajapet extension to the west of the Bangalore Fort, which latter is expected to become the heart of the city after all the extensions contemplated are completed. This is 196 acres in extent.

11. The second one called the Basavangudi extension, arose after the advent of the plague in 1898. A regular plan of the lay-out was prepared and house and bungalow sites allotted. The area of this extension is 440 acres.

12. Shortly after, the opening out of another suburb on the north was found necessary and accordingly 291 acres of land were acquired and laid out and named the Malleswaram extension after the name of a god for whom a temple of old celebrity existed in the area.

13. Recently in the year 1907, a fourth extension, *viz.*, the Shankarpur or Mutt extension, was laid out to form a connecting link between the Chamarajapet and the Basavangudi extensions. This occupies 162 acres.

14. The total area of the above four extensions as laid out up to date is 1,089 acres, which, with the area of the city proper, 666 acres, brings the total extent of built area to 1,755 acres. (*Vide* General Survey, Plan No. 1).

15. *Future requirements.*—The Chamarajendrapet extension contains a population of about 5,000. It may be considered to have attained its full development.

In the remaining three extensions there are about 4,000 house-sites. Allowing 5 persons on an average to each house, there is accommodation for 20,000 in the three extensions when fully developed. Their present population is only 6,000 and there is thus room to accommodate 14,000 more.

For the remaining 5,000 and future increase of population, new extensions will be needed. One such extension is possible to the east of the Fort centre road in the area marked yellow on plan No. 1, and it will form a counterpart of the new Mutt extension lying to the west of the same.

3.—The Design of the Extensions.

16. *The lay-out.*—All the extensions more or less have been laid out on the grid-iron or chess-board plan. They are rectangular with the boundary roads running north and south and east and west and all intermediate streets and lanes parallel to them. In only one, *viz.*, the Basavangudi extension, are added four diagonal roads terminating at the four corners of a public square in the centre of the extension. This uniform plan seems to have been adopted mostly to enable houses being built facing the principal cardinal points, in accordance with ancient Hindu custom as already noticed in paragraph 9, *supra*. Each row of houses is divided by a narrow conservancy lane on to which abut the backyards of houses. These lanes form a distinguishing feature of the Bangalore extensions.

The approach roads to the extensions, the boundary and the diagonal roads are all made 100 feet wide. The rest of the roads vary from 40 to 60 feet, and the conservancy lanes are 12 to 15 feet in breadth.

4.—Buildings in the Extensions.

17. *Preliminary.*—In all the extensions, for ordinary middle class dwelling-houses a frontage of 30′ is reckoned as a unit, and one, two or three units are permissible for a house site. For cottage sites, 75′ × 150′ has been adopted as the standard. For bungalows, larger dimensions ranging from 240′ × 200′, to extents of 3 or 4 acres have been allotted. On an average a density of 22 to 40 souls per acre of gross area has been aimed at in these extensions against 50, the actual realised in London. It will be seen that these extensions have been made very airy and perhaps laid out on a rather lavish scale. They are likely to tax the resources of the municipality in maintaining the long length of wide roads and in providing other sanitary conveniences.

18. In the Chamarajapet extension most of the houses were allowed to be built on the contiguous system. In the later extensions undertaken after the advent of the plague, the detached system whereby houses are separated from each other by more or less open spaces has been adopted. The latter certainly secures better light and ventilation, although the contiguous houses present a better street picture.

The houses are of various types ranging from the smallest sized dwelling-house to palatial structures having some pretensions to architectural beauty. The wide roads, the substantial character of the houses and their varied frontage, with spacious compounds often planted with fruit trees and flower gardens, make these extensions the most unique of their kind in India. In spite of some defects and deficiencies whose removal is delayed by financial exigencies, they reflect credit on the engineers and statesman responsible for these extensions. These commodious and salubrious suburbs justly excite the admiration of visitors from other parts of India.

19. *Some disadvantages of the lay-out.*—The design adopted although unimpeachable from a sanitary point of view, gives a stiff monotonous appearance to all the extensions, while the fancied symmetry can be observed only on paper. Being thus laid out according to a preconceived plan without due regard to the natural features of the ground, the lay-out lacks the beauty of perspective and variety of landscape which would have resulted if attempts had been made to suit the plan to the ground and not the ground to the plan. This lesson will have to be borne in mind in subsequent extensions of the city. The design adopted is not the best from an æsthetic point of view. It has also caused some practical inconvenience to the resident public. The roads in the Chamarajapet and Malleswaram extensions merely follow the natural lie of the ground and this has resulted in very steep gradients, while attempts to secure easier grades in the Basavangudi extension necessitated deep and unsightly cuttings, rendering in some cases approach to the adjoining bungalows and houses difficult. Deep sewer manholes and unnecessarily large storm-water drains have also become necessary by the disregard of the natural contours of the ridges on which the extensions have been located. The steep slopes also render it difficult to keep down velocities in the storm-water drains and sewers within permissible limits. Numerous drops along the course of storm-water drains have thus become necessary and the beds of the drains along a few streets have had to be kept much below the road formation. Expensive side revetments have become necessary to protect the roadside, confine the road material and prevent rapid

scouring away of sides and washing in of the road detritus into the drains, which, swept along with water at high velocities, is found very destructive to the inner surface of these drains. All this inconvenience and expense could have been considerably minimised by a more suitable lay-out, with reference to the contour of the ground.

20. *Improvements required.*—Moreover, the extensions as now laid out are scattered and detached (*vide* Plan 1). To blend them into a harmonious whole and make them look like the component parts of a unified design, several connecting links in the form of further residential blocks, parks, recreation grounds and above all, a girdle road enclosing the whole city, seem to be necessary. The details of these are now being worked up on more modern principles of town-planning and town-improvement with due regard to the requirements of sanitation and civic adornment.

21. One cardinal mistake in all the extensions was that storm-water drainage, sewerage and water-supply to the extensions were not completed before people were allowed to build houses on the sites. Immediately after the imperfect formation of the skeleton of roads and lanes, there was a rush for building sites and houses sprang up with great rapidity. Sewage-logging of soil commenced. The necessary measures for drainage, sewerage and water-supply were then taken in hand, but provision was not made for connecting the house sewage with the street sewers. The system has not therefore produced all the benefits expected of it. The compounds and backyards of most of the houses still good of sewage and sewage-logging is going on imperceptibly. The utility of a costly sewerage scheme without the provision for the necessary house connections or without the legislative powers for enforcing such connections from the house owners, is open to question. Estimates for any extensions that may hereafter be taken up must include complete provision for laying out, drainage and sewerage, including house connections and only when all these have been fully completed should permission be given to build houses on the allotted sites. Any departure from this scientific procedure is sure to make these extensions gradually insanitary and will be attended with harmful consequences.

5.—Drainage of the Extensions.

22. *Disposal of storm-water.*—The extensions are located on high ground. The soil is hard and gravelly and well drained. . It is a remarkable feature of these extensions that after the heaviest downpour of rain there is not a single place where a pool of water is to be seen. The drains constructed on roadsides and across the subsidiary valley lines of the extensions carry away the storm-water to the different outfalls in the quickest possible time.

23. *Run-off assumed in designing the drains.*—It is found from records of rainfall in Bangalore that the maximum intensity of rainfall per hour in ordinary years is 2 inches. A greater intensity than this occurs very rarely and at intervals of 20 to 30 years. In 1911, over 3·50 inches per hour was gauged in the month of September, but this is the exception and not the rule. The storm-water drains in the extensions have been designed to take a run-off of 2 inches per hour and found to work satisfactorily in all ordinary years. The main outfall of the city based on such a run-off proves too small. During exceptionally heavy storms, the water overtops the sides and backs up along the low level inlets emptying into the outfall; and then flooding of houses and damage to property situated along the outfall and in the low level areas, are the inevitable consequences. Such was actually the case in the year 1911, when about 50 houses collapsed and about 200 people were rendered homeless. Remedial measures are now under contemplation to avoid the recurrence of such damage in future. Obviously, it would be most uneconomical and highly extravagant to design these outfalls to take a maximum rainfall per hour occurring once in 20 or 30 years, but at the same time it is necessary to provide, as far as human ingenuity could devise, some means to avert the evil consequences of such extraordinary floods in the outfalls running through the heart of the inhabited area. Wholesale acquisition of such low-lying properties up to the H. F. L. contour and their conversion into open spaces or parks are suggested. Another suggestion is made in order to minimise the cost of wholesale acquisition, to confine it to a narrow margin on both sides of the outfall and construct flood banks with suitable flap valves at the mouth of the inlet drains. Such calamities are of very frequent occurrence in many towns and remedial measures have to be undertaken. The problem presents some difficulties and its satisfactory solution deserves the consideration of this Conference.

6.—The Sewerage of the Extensions.

24. *Short description of the system.*—The sewerage of these extensions, with the exception of the Shankar Mutt extension where the separate system of sewage has been adopted and direct house connections to street sewers have been given (*vide* Plan No. 11), is on the combined system of open drains and underground sewers which found favour with the sanitary authorities some years ago. The open drains

in the conservancy lanes receive all the sullage from the houses, and this is led into an underground sewer starting at the end of the open drain and connected to it by means of a gully trap arrangement whereby the sewage proper enters the sewer; but any excessive rain water getting in is excluded from the outfall works by means of storm overflows along the pipe sewers. The open drains in the conservancy lanes are flushed by means of bent tube flushing syphons and the underground sewers by means of flushing tanks fitted with Field's flushing apparatus.

25. *Purification works.*—Land purification is resorted to at the outfalls, of which there are four on the gravitation system. The outfall works are of a simple nature, consisting only of a grit chamber and settling tanks of sufficient capacity. The effluent from the tanks is applied direct to land. The analysis made of the different effluents gives satisfactory results.

26. *The defects of the system.*—This system after some years of working is found to be unsatisfactory as the open drains bring a large amount of grit and rubbish to the gully traps which easily get choked up and there is an overflow of sewage into the storm-water drains, spreading offensive and unhealthy effluvia all over the extensions.

Further, in the absence of direct house connections to the underground sewers and arrangements to isolate and carry off every drop of sullage from the premises, what is not absorbed by, or deposited in, the backyards, only gets into the open drain at the conservancy lane.

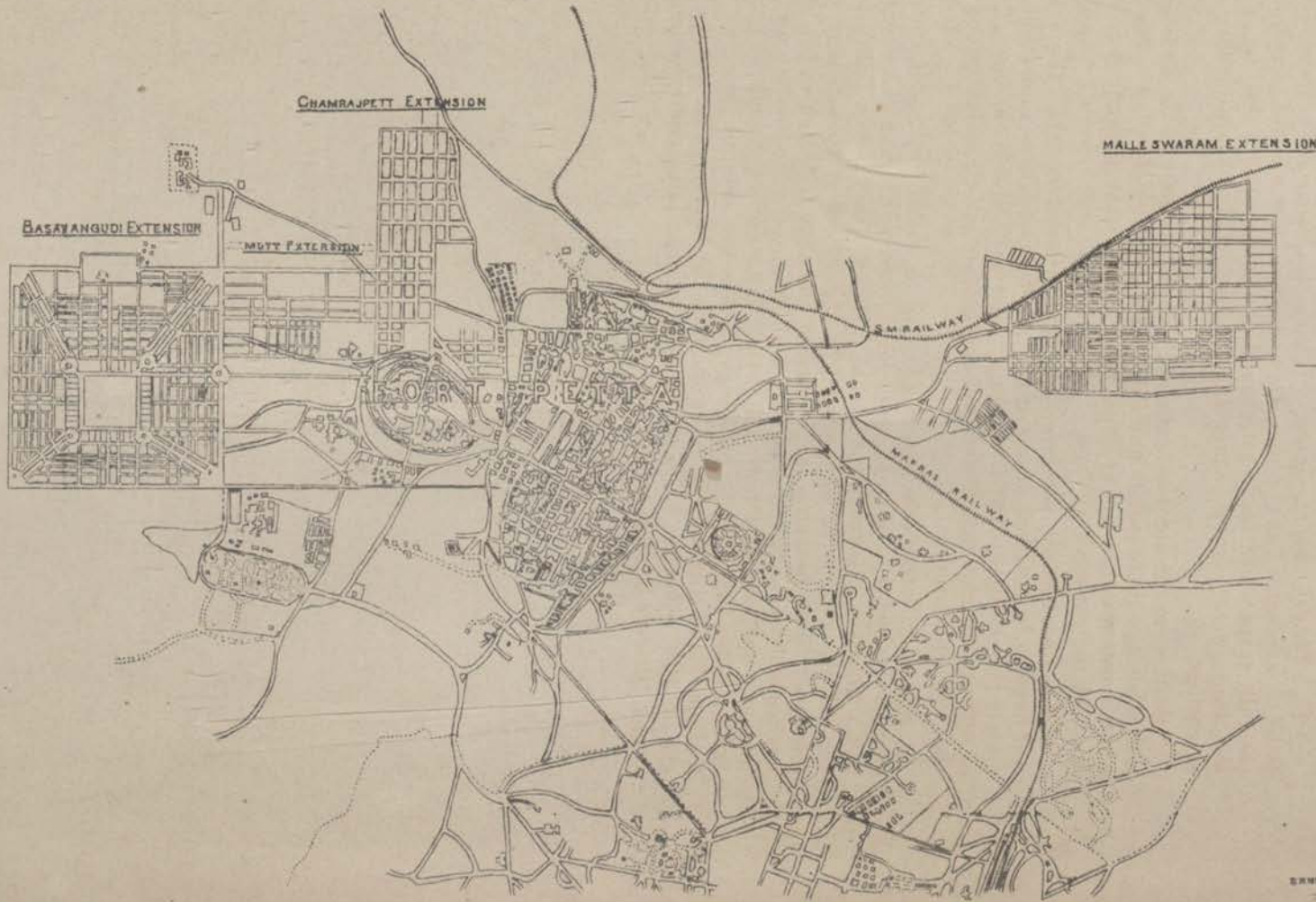
27. *Improvements necessary.*—It is thus apparent that the existing system will have to be modified sooner or later, and direct house connections given. The system is so designed that it will easily lend itself to this change. The sewers are of sufficient diameters, are well laid and have a self-cleansing velocity. They are also well ventilated.

Some legislative enactment seems to be called for, making it incumbent on every house owner to provide means for the effective removal of all sullage and filth in his premises. Government should undertake this responsibility in the case of the indigent and try to recoup itself by the levy of a conservancy cess. In the absence of these measures, costly drains and sewers laid along the different roads but partially serve the purpose they are intended for; and outlay on such schemes, however elaborate in design and perfect in execution, cannot be justified as they fail to attain their object completely, unless the sanitary sense of the public is awakened and stirred up to co-operate with the Municipal Bodies and Town Councils in their efforts to eradicate the evils of insanitation and to prolong life, and render existence healthy and happy.

SHEET No 1

MAP OF THE BANGALORE CITY WITH THE EXTENSIONS

Scale 3 inches to 2 Mile

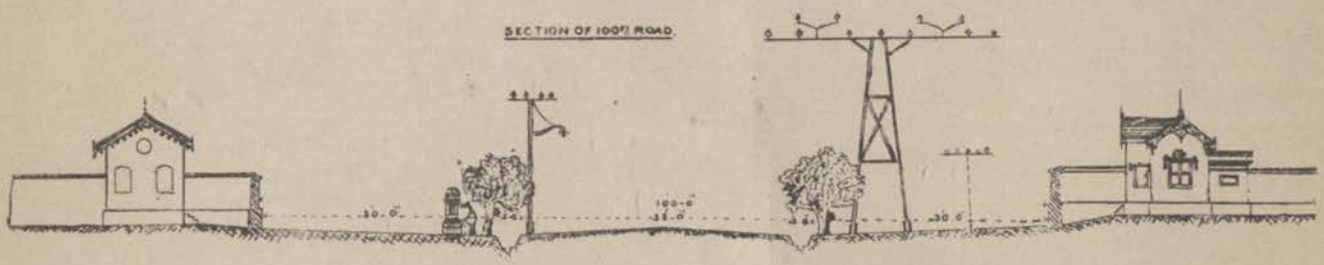


SANITARY ENGINEER
SANITARY DIVISION

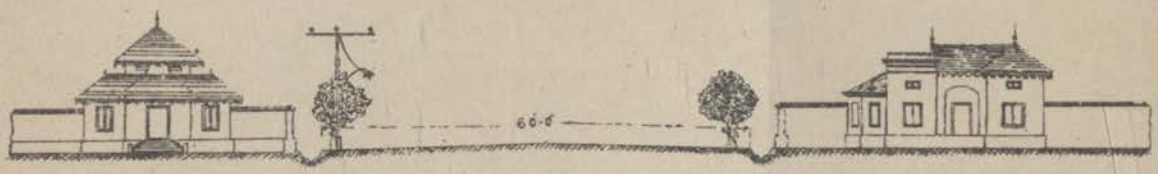
SHEET No. 2

SECTIONS OF ROADS & STREETS IN THE EXTENSIONS

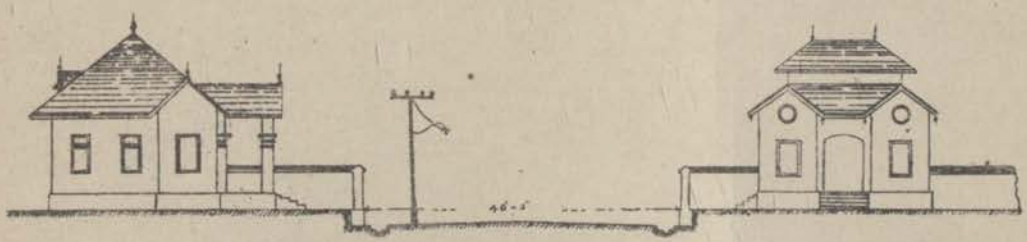
SECTION OF 100ft ROAD.



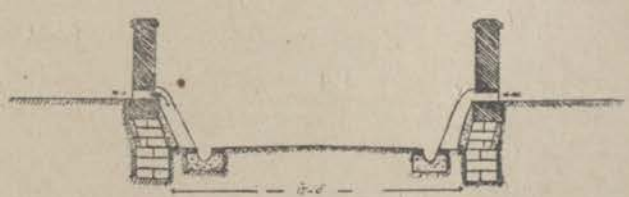
SECTION OF 60ft ROAD.



SECTION OF 40ft STREET.



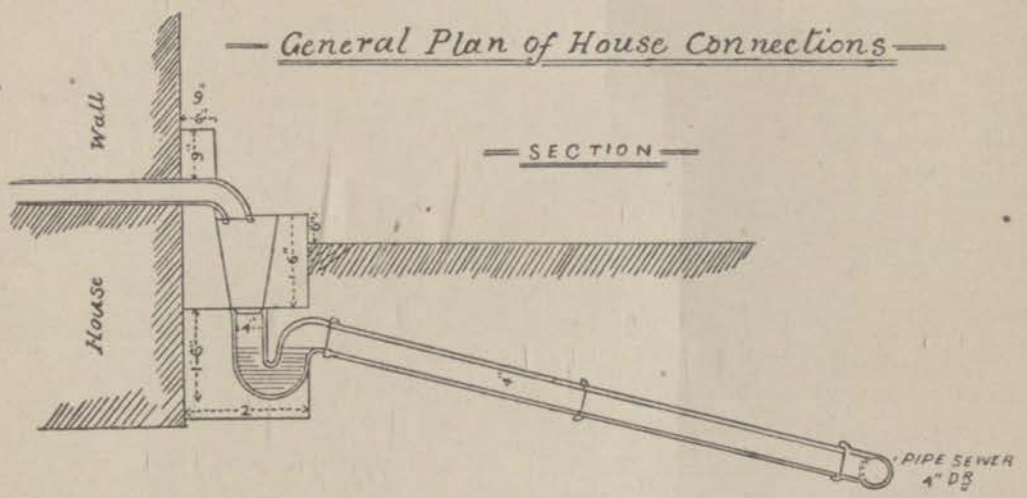
SECTION OF CONSERVANCY LANE.



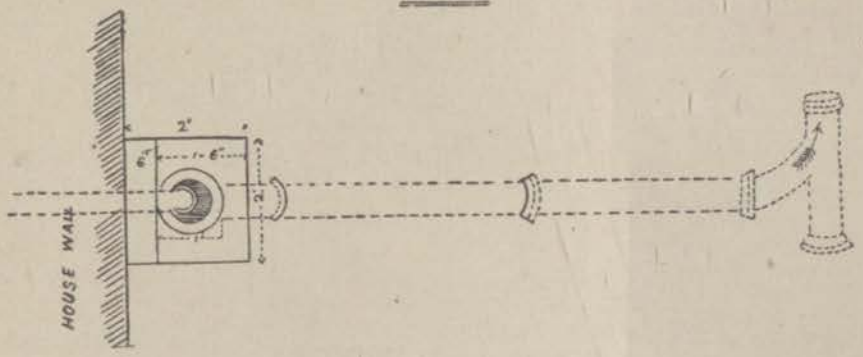
PLAN No. 3.

General Plan of House Connections

SECTION



PLAN



PROPOSED TYPE OF MANHOLE FOR DRAINAGE WORKS

SCALE 4 FEET TO ONE INCH

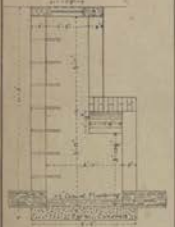
SHEET Nº 4.

Design Nº 1

Manhole of 4'×4'×6'

Cost Rs 75

Section on BB



Plan

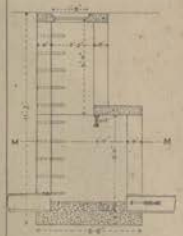
Section DD

Design 2

Manhole of 4'×4'×6'

Cost Rs 96

Section NN



Plan MM

Plan at Top

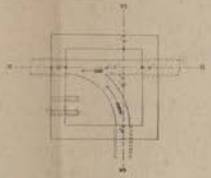
Design 3

Manhole of 4'×4'×6'

Cost Rs 80

Section RR

Plan QQ



Section on SS

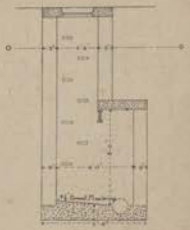
Top Plan

Design 4

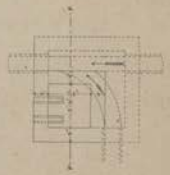
Manhole of 4'×6'×6'

Cost Rs 96

Section PP



Plan OO



Plan at Bottom

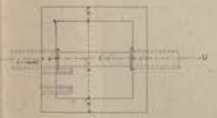
Design 5

Manhole of 4'×6'×6'

Cost Rs 61

Section UU

Plan TT



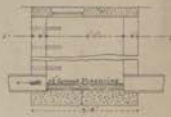
Note — Cost of Prefabricated Circular Manholes —

Cost of circular Manholes of 3' dia. & 3½ high @		
— do —	do	4' — do — 38
— do —	do	5' — do — 57
— do —	do	6' — do — 81
— do —	do	7' — do — 103
— do —	do	8' — do — 127

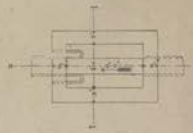
Design 6

Manhole of 4'×3'×3'	Cost Rs	47
do 4'×4'×4'	do	51
do 4'×5'×5'	do	69
do 4'×5'×6'	do	83
do 4'×6'×6'	do	93

Section HH



Plan JJ



Section II

"True copy of approved plan."

Executive Engineer
Sanitary Engineering Division
Bangalore

00110609

Digitized with financial assistance from
Shri Brihad Bhartiya Samaj
on 31 October, 2019